MACHINERY

SEPTEMBER 10, 1958 ONE SHILLING & THREEPENCE

HyPowermatics

plain and duplex

CINCINNATI

★ Table control - single lever
★ Table feeds - infinitely variable ½ to 150in./min.
★ Table rapid traverse rate - up to 200in./min.
★ Effective climb milling - backlash eliminated automatically with Hydramech unit.
★ Spindle carrier - self-contained 7½ to 50 h.p. drive
★ Cutter retraction - single or double - automatic (on demand)

42 sizes available of both Plain and Duplex styles
IN ADDITION, this entire range is available with Automatic Tracer Control to vertical movement of the spindle carrier.

Write for Catalogues No. M.1871E and M.1909E

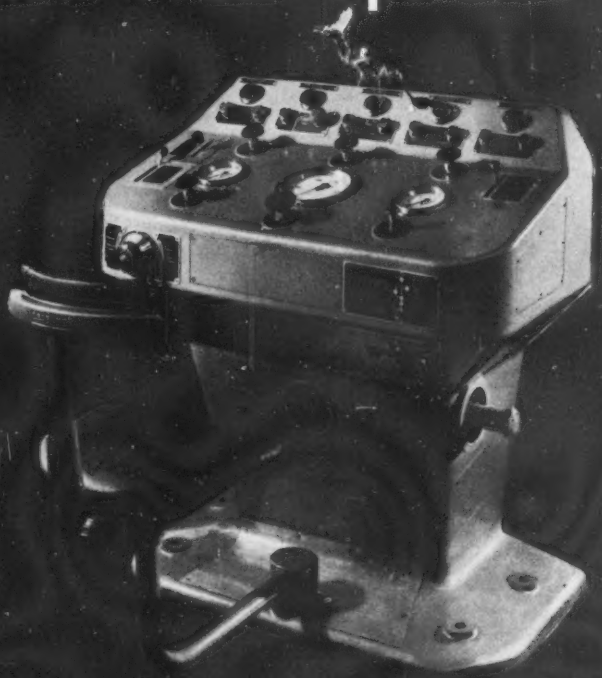
CINCINNATI MILLING MACHINES LTD
BIRMINGHAM, 24.

MILLING MACHINES

Representatives CHARLES CHURCHILL & CO LTD LONDON BIRMINGHAM MANCHESTER GATESHEAD GLASGOW

The modern Press Operator

SITS here



The Towler hydraulic control desk allows the operator to concentrate on the work-piece since all he has to use are finger-light controls which are immediately to hand and instantly responsive.

For forging or extrusion, metal forming, rubber or plastic moulding or any other type of press or hydraulically operated machine, the Towler Autodraulic System together with Towler Electraulic Pumps give economy, speed and precision, plus eyes-on-the-job-quality in your processes.

Write or telephone for literature or to see one of our films. We have an engineer in your area available to discuss your requirements in hydraulics.

ELECTRAULIC PUMPS CONTROLS AUTODRAULIC

TOWLER BROTHERS (PATENTS) LTD
RODLEY NR. LEEDS ENGLAND
Tel: Pudsey 3125/6 7/8 GRAMS: Electrolic, Rodley

WICKMAN LIMITED

Factored Machine Tool Division

FLETCHAMSTEAD HIGHWAY · COVENTRY · TELEPHONE: COVENTRY 74321

Representing in the United Kingdom—

Metal-cutting Machines

ASPLUNDWERKEN
Deep Hole Boring Machines.

BAKER BROS.
Keyseating and Special Purpose Machine Tools.

CARLTON
Radial Drilling Machines from 12 ft. arm and 4 in. dia. hole to 6 ft. arm and 3in. drilling capacity.

COLLET & ENGELHARD
Horizontal Boring Machines, floor and table types, Die Sinking Machines.

DAVENPORT
Multi-spindle Automatic Screw Machines.

DUBIED
Copying Lathes.

GRENCHENER
Automatic copying machine (turning, facing, boring).

GYGI
Single-Spindle Turning and Screwing Automatics.

HABERSANG & ZINZEN
Drilling, Tapping and Reaming Machines; Multi-spindle Multi-station, Rotary and in-line Transfer Machines.

HELLER
Vertical, Horizontal and Plano-milling Machines; Boring and Facing Machines, Transfer Lines, Cold Saws, Special Purpose Machines.

KLOPP
Mechanical and Hydraulic Shaping Machines.

KOPP
Profile and Copy Milling Machines.

LeBLOND
Lathes and Automatic Crankshaft-Turning Machines.

LELAND-GIFFORD
Standard and Special Sensitive and Hydraulic Feed Drilling Machines.

LORENZ
Gear Hobbing and Gear Shaping Machines.

VICTOMATIC
Production Milling Machines.

WARNER & SWASEY
Capstan and Turret Lathes and Single Spindle Chucking Autos.

WEBSTER & BENNETT
Vertical Turning and Boring Mills.

WEIPERT
Production, Multi-tool Engine and Toolroom Lathes.

WICKMAN-MOULTON
Thread Milling Machines.

Grinding and Honing Machines

DUBIED
Tool Grinding Machines

HABIB
Universal Tool and Cutter Grinding Machines

MIPSA
Universal Precision Cylindrical Grinding Machines.

NAGEL
Honing and Superfinishing Machines.

NAXOS-UNION
Plain and Universal, External, Camshaft, Crankshaft, Surface and Roll Grinding Machines.

ORTLIEB
Drill, Tap and Die Grinding Machines.

SCRIVENER
Centreless and Surface Grinding Machines.

THIELENHAUS
Fully Hydraulic, Semi-Automatic and Centreless Micro-Finishing Machines.

Metal Forming Machines

DUCHSCHER-WECKER
Swaging Hammers for cold and hot forming.

ERCO
Stretching, Forming, Shrinking, Punching and Rivetting Machines.

EUMUCO
Forging Presses, Hammers and Upsetting Machines.

H.P.M. (U.S. and British built)
Injection Moulding and Diecasting Machines, and Hydraulic Sheet Metal Drawing Presses.

HEENAN
Wire and Strip Forming Machines.

HERLAN
Impact Extrusion Presses and Collapsible Tube Plant.

HUFFORD
Stretch-Wrap Forming, Levelling, Sizing and Spin Forge Machines.

MAY
Cold Forming Presses.

NIAGARA
Automatic machines for light and heavy gauge sheet metal drums. Sheet Metal Working Machines.

PINES
Tube Bending Machines.

TIBO-YODER
Electric Weld Tube Mills and Cold Roll Forming Machines.

WEINGARTEN
Precision Screw, Transfer, and High Speed Automatic Presses.

WELDALL & ASSEMBLY
Hydraulic and Mechanically operated Press Brakes and Guillotines.

YODER CO. OHIO
Electric Weld Tube Mills, Cold Roll Forming Machines, Slitting and Cut-off Machines.

Toolroom and Instrument Manufacturing Equipment

HAUSER
Jig Boring and Jig Grinding Machines, and machines and equipment for clock, watch and instrument manufacture.

LAMBERT
Precision Gear Hobbing Machines.

SCHAUBLIN
Precision Milling Machines and Precision Lathes.

ULTRA
Cam Turning Cutters and, Recess and Milling Machines

WYSSBROD
Gear and Pinion Cutting Machines.

Testing Equipment

LOSENHAUSEN
Material Testing and Balancing Machines.

★ **Catalogues for any of the machines listed will be gladly sent on request.**

516 WM

The modern Press Operator

SITS here

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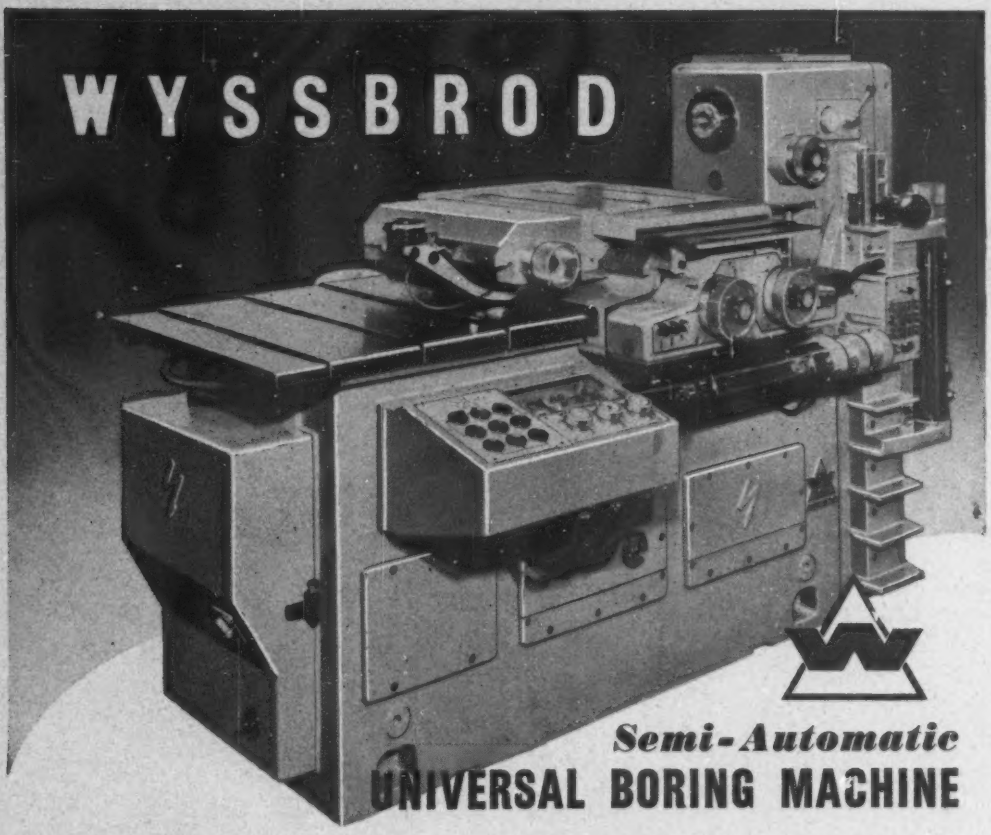
516 WM

WYSSBROD



Semi-Automatic
UNIVERSAL BORING MACHINE

- **Single or series production** ■
- **Repetitive co-ordinate positioning** ■
- **Automatic clamping and unclamping of the slides** ■
- **Electro-hydraulic control** ■
- **Optical readings to 0.0004″** ■
- **Light precision milling if required** ■
- **Rotary table 16″ x 16″ optional** ■

Brief specification :-	Model B57
Dimensions of table	20″ x 20″
Longitudinal stroke	20″
Transverse stroke	12″
Vertical stroke	12″
Feeds (stepless) ins/min.	2–11¼
Spindle speeds, r.p.m. (16 steps)	40–4000

This hydraulically-operated machine, built by an old-established Swiss company to traditional Swiss standards of precision, is an economical production jig borer suitable for "one-off" or series production, without the need for costly jigs and fixtures.

Its system of repeat co-ordinate setting, allied to robust construction, ensures consistent positional accuracy to 0.0004″. The table and headstock clamp and unclamp automatically, but can be released for milling operations, and the spindle speeds can be changed automatically if required.

Outstanding features are hydraulic power to the table and headstock ; stepless feeds ; wide range of spindle speeds ; manual fine adjustment ; optical scales, and centralised controls.

WICKMAN LIMITED

FACTORED MACHINE TOOL DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

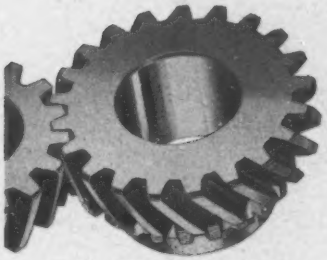
Telephone : Coventry 74321

524F13/66

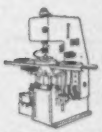
NAGEL

HONING

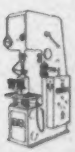
MAKES RUNNING PARTS RUN BETTER



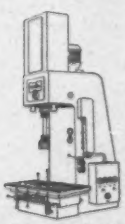
Nagel Horizontal Honing Machine. Capacity from ¼" to 2½" dia. bores.



Nagel Brake Drum Superfinishing Machine. Automatic work cycle with hydraulic clamping.



Nagel VM Type High Duty Machine especially suitable for hard-chromed components.



Nagel Long Stroke Honing Machine. Strokes from 24" to 48" with capacity from 1½" to 20" dia. bores.

Honing of close-limit components eliminates heavy initial wear, and allows closer tolerances, thus increasing considerably the reliability and performance of all classes of product on which honing is used.

Superfinishing of internal and external surfaces can be carried out on a mass-production basis using Nagel Honing Machines—with the added advantage of automatic cycle operation on certain machines.

Mass production of honed components to the highest limits of accuracy can be obtained by using the Nagel Automatic Cycle double-spindle machine complete with Special Nagel Sizing Equipment.

A high level of production is also possible, however, with the push-button controlled single spindle machines which incorporate the special Nagel features of infinitely variable hydraulic operation of all movements of the machine, including tool adjustment and speed.

A leaflet is available from :—

WICKMAN LIMITED

FACTORED MACHINE DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY
Telephone: Coventry 74321

430F72

Here at last . . . . the Swiss-built precision grinding machine that industry has been waiting for.

MIPSA Push-button Precision Grinding

Brief Specifications

	Type RUE 150 x 400	Type RUE 150 x 780
Height of centres	8¼"	8¼"
Max. between centres	18½"	29½"
Max. diameter admitted	9¼"	9¼"
Max. stroke of table	17"	30½"
Min. stroke of table	·04"	·04"
Swivel of upper table	14°	14°

Toolrooms and production shops looking for positive accuracy in the production of small components have it here with push-button simplicity.

Increments as small as a half of one-tenth of a " thou " (0.00005") can be applied by the pressure of a button. Servo-controlled hydraulic feed mechanisms automatically adjust the stop by means of a micro-corrector, entirely eliminating the old trial and error method of applying increments by handwheel.

The hydraulic system of table feed coupled with the special micrometer stop make it possible to accurately grind shoulders in relation to one another by the simple use of gauge blocks.

The machine itself is built to typically high Swiss standards and is fully universal in application. The wheelhead rotates through 360 degrees, an internal grinding wheel spindle is fitted, and a second wheel can be applied for the production of tapers. Plunge or traverse grinding can be operated with the same facility.

Catalogue on request

WICKMAN LIMITED

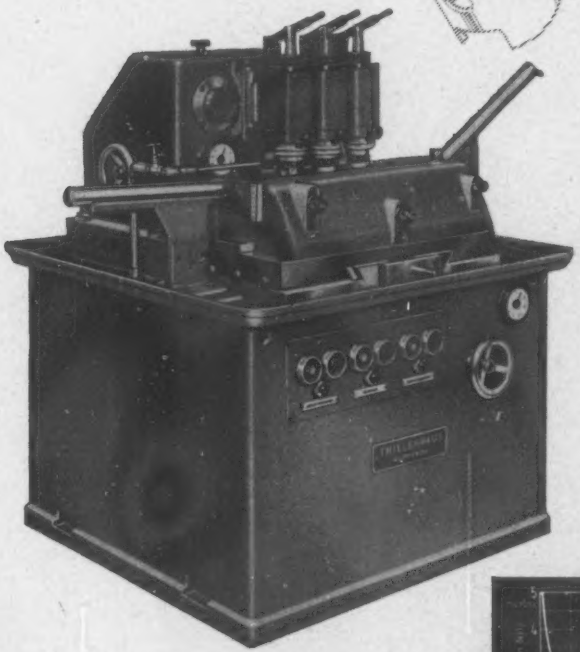
FACTORED MACHINE DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY
Telephone: Coventry 7432

When answering advertisements kindly mention MACHINERY.

THIELENHAUS

MICROFINISHING

is the *QUICK* answer to surface finishing problems

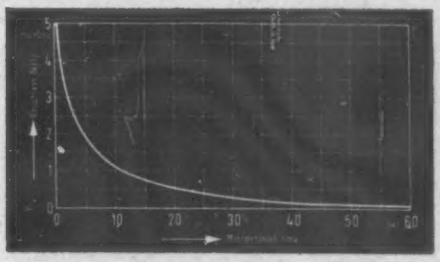


Microfinishing produces smooth, high percentage bearing surfaces with sound crystalline base structure, greatly extending the life of highly stressed parts, which with production rates possible on Thielenhaus machines offers the two-fold gains of :

Improved functional quality and
Higher production.

This graph shows the relationship between surface roughness and microfinishing time. The rough surface of coarse peaks and valleys is quickly reduced and a roughness in the order of 12 M.I. (RMS) achieved in about 10 seconds. As the bearing portion increases so does the amount of material to be removed and the time required.

Roughness values between 1 and 2½ M.I. (RMS) can be produced on automobile crankshafts in a machining time of between 40 and 60 seconds.



The centreless machine illustrated is designed for small and medium sized components requiring either continuous or plunge-cut finishing. It is made in three sizes up to 5" dia. capacity. Thielenhaus machines are also available for micro-finishing crankshafts, camshafts, brake-drums, pistons, bearings and races, etc. A descriptive catalogue will be gladly sent on request.

WICKMAN LIMITED

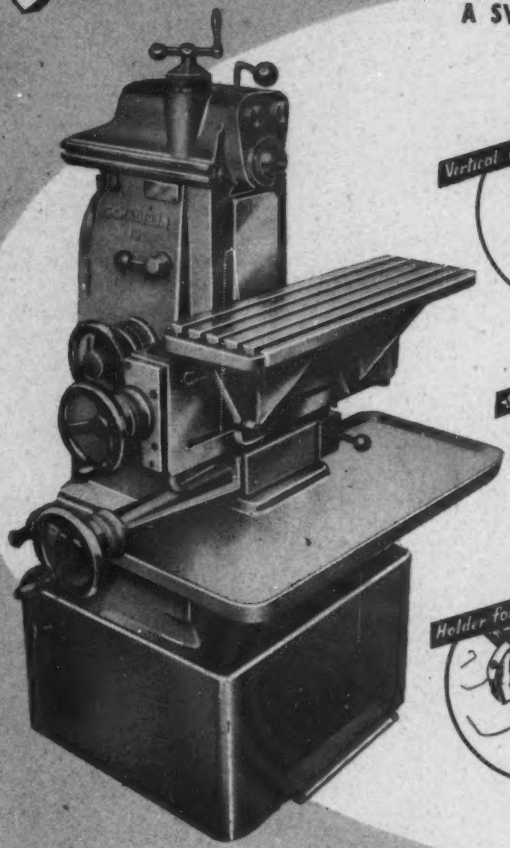
FACTORED MACHINE DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

Telephone: Coventry 74321

504 F 65

Schaublin SV 13

A SWISS PRECISION MILLING MACHINE MADE FOR ALL WORK



Write to-day for catalogue giving further details of this machine.

For precision milling in tool and die-making shops, development and research departments, and wherever highly accurate work is the first requirement. A truly universal machine built to exceptionally high Swiss standards.

WICKMAN LIMITED

FACTORED MACHINE TOOL DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

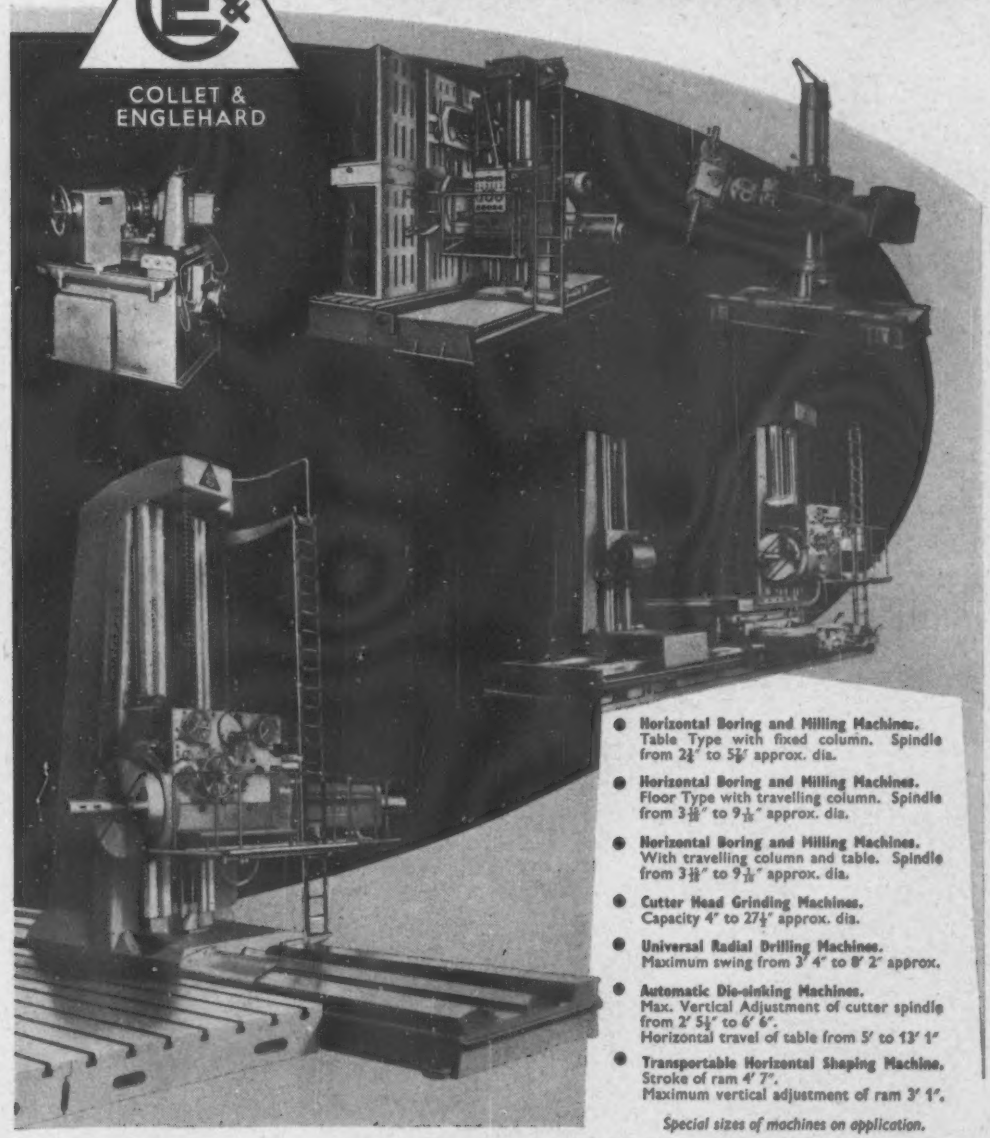
Telephone: Coventry 74551

404 P14

COLLET & ENGLEHARD

high production

PRECISION MACHINE TOOLS



- **Horizontal Boring and Milling Machines.** Table Type with fixed column. Spindle from 2¾" to 5⅞" approx. dia.
- **Horizontal Boring and Milling Machines.** Floor Type with travelling column. Spindle from 3⅛" to 9⅛" approx. dia.
- **Horizontal Boring and Milling Machines.** With travelling column and table. Spindle from 3⅛" to 9⅛" approx. dia.
- **Cutter Head Grinding Machines.** Capacity 4" to 27½" approx. dia.
- **Universal Radial Drilling Machines.** Maximum swing from 3' 4" to 8' 2" approx.
- **Automatic Die-sinking Machines.** Max. Vertical Adjustment of cutter spindle from 2' 5½" to 6' 6". Horizontal travel of table from 5' to 13' 1"
- **Transportable Horizontal Shaping Machine.** Stroke of ram 4' 7". Maximum vertical adjustment of ram 3' 1".

Special sizes of machines on application.

WICKMAN LIMITED

FACTORED MACHINE DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

Telephone: Coventry 74321

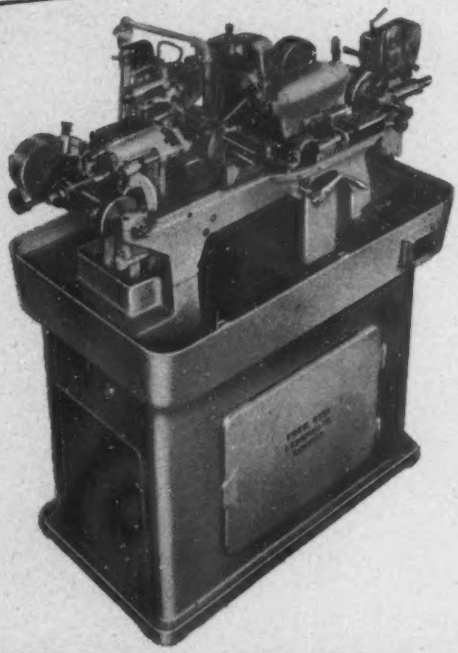
514 FB1/10

GYGI

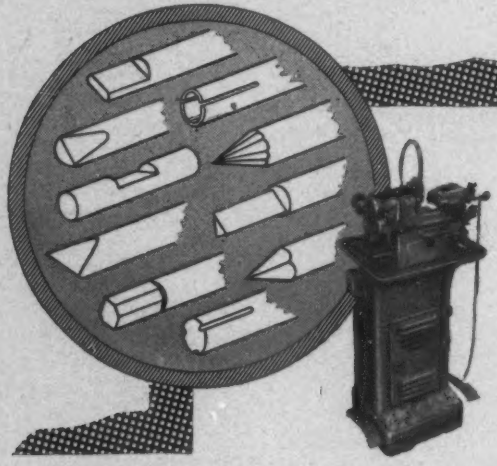
Precision Turning and Screw Cutting Automatic

For simplicity of set-up with high output.

This Swiss high-precision sliding head automatic is suitable for the economic manufacture of turned and screwed parts in small or large quantities The standard cams cover the great majority of the machine's possible operations, so that change-overs are speeded up by eliminating cam-making. Thus the machine has the flexibility and easy set-up of the capstan combined with the high output of the automatic. 3, 4, or 5 tool slides are available, and the machine's versatility is further increased by interchangeable end-working attachments for slotting, drilling, undercutting, copying, tapping and threading, either right or left-hand, up to the maximum bar capacity of the machine.



Brief specification :-		GL 16/7	GL 16/10
Maximum bar capacity.	round	17/64"	25/64"
	hexagon, A/F	15/64"	23/64"
	square, A/F	13/64"	17/64"
Maximum length turned ...		2"	2"
Maximum diameter threaded, M.S.		17/64"	17/64"
Spindle speeds, r.p.m. (16 steps)		2800–8200	2800–8200



Multiple Flat Milling or Grinding Machine

A semi-automatic multi-purpose machine for performing second-operation grinding or milling, in-feed, longitudinal and conical, on components up to $\frac{3}{8}$" diameter. Rapid loading and unloading assures economical batch or series production.

Brief specification :-	GL 17
Maximum bore of collet ..	$\frac{3}{8}$"
Maximum diameter of work...	11/32"
Maximum length machined ...	$1\frac{1}{2}$"

WICKMAN LIMITED

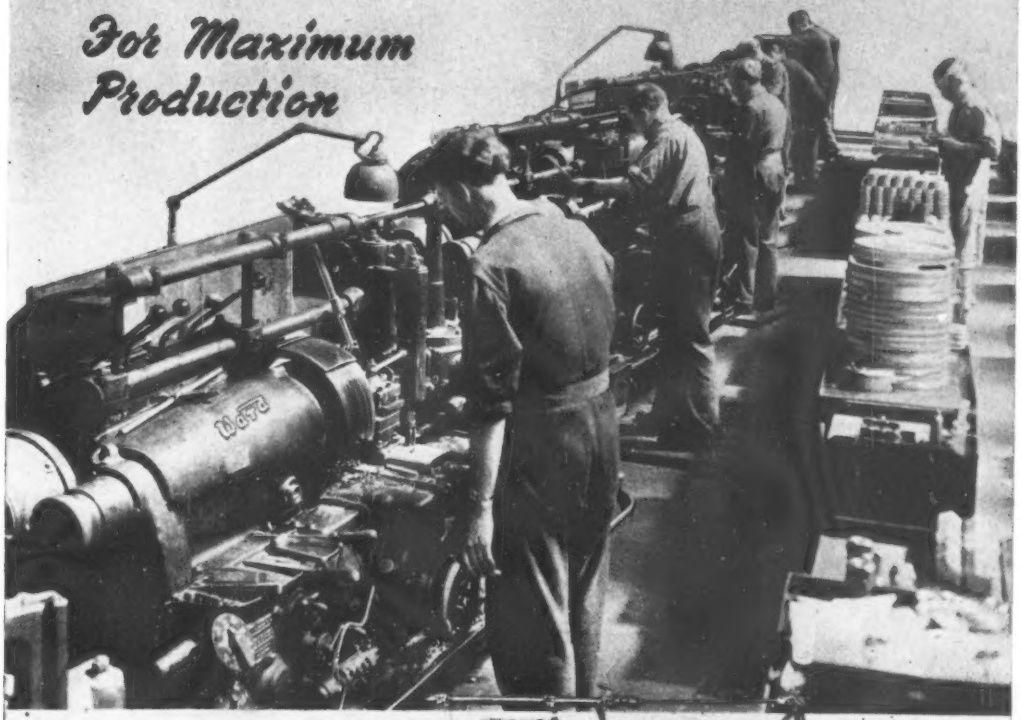
FACTORED MACHINE TOOL DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

Telephone: Coventry 74321

523 F 18/61

Ward No. 7 COMBINATION TURRET LATHES

For Maximum Production



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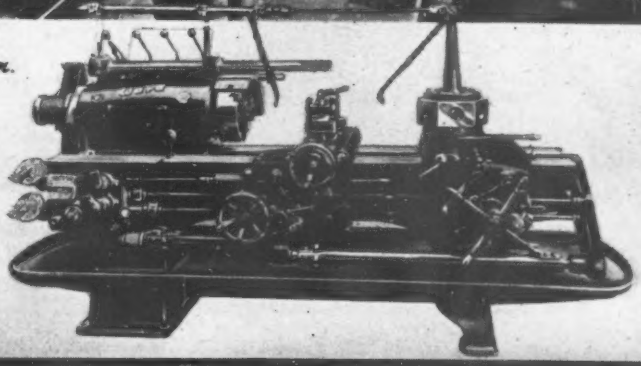


Swing over stainless steel covers . . . . . 16 in.
Swing over saddle up to cross slide . . . . 14½ in.
Diameter of hole through spindle . . . . . 2½ in.
Hydraulic actuation of driving clutch giving finger tip gear change.

H·W·WARD & CO LTD

SELLY OAK
BIRMINGHAM 29

TELEPHONE SELLY OAK 1131

BRITISH MACHINE TOOL MAKERS ASSOC. LTD

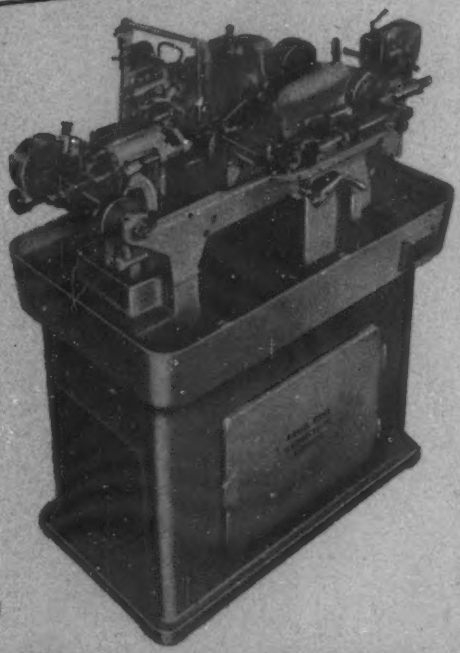
W667
B

GYGI

Precision Turning and Screw Cutting Automatic

For simplicity of set-up with high output.

This Swiss high-precision sliding head automatic is suitable for the economic manufacture of turned and screwed parts in small or large quantities The standard cams cover the great majority of the machine's possible operations, so that change-overs are speeded up by eliminating cam-making. Thus the machine has the flexibility and easy set-up of the capstan combined with the high output of the automatic. 3, 4, or 5 tool slides are available, and the machine's versatility is further increased by interchangeable end-working attachments for slotting, drilling, undercutting, copying, tapping and threading, either right or left-hand, up to the maximum bar capacity of the machine.



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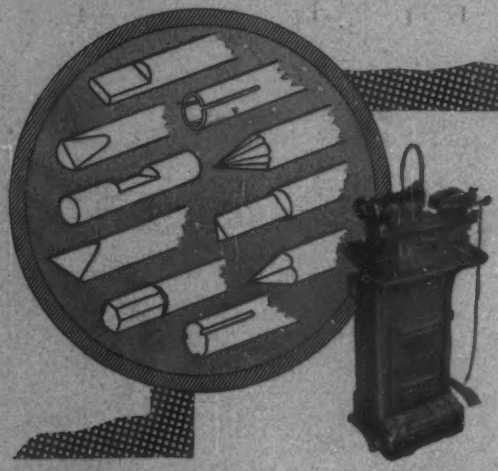
	square, A/F	13/64"	17/64"
Maximum length turned ...		2"	2"
Maximum diameter threaded, M.S.		17/64"	17/64"
Spindle speeds, r.p.m. (16 steps)		2800–8200	2800–8200



Multiple Flat Milling or Grinding Machine

A semi-automatic multi-purpose machine for performing second-operation grinding or milling, in-feed, longitudinal and conical, on components up to $\frac{3}{4}$" diameter. Rapid loading and unloading assures economical batch or series production.

Brief specification :-	GL 17
Maximum bore of collet ..	$\frac{3}{4}$"
Maximum diameter of work...	11/32"
Maximum length machined ...	$1\frac{1}{4}$"

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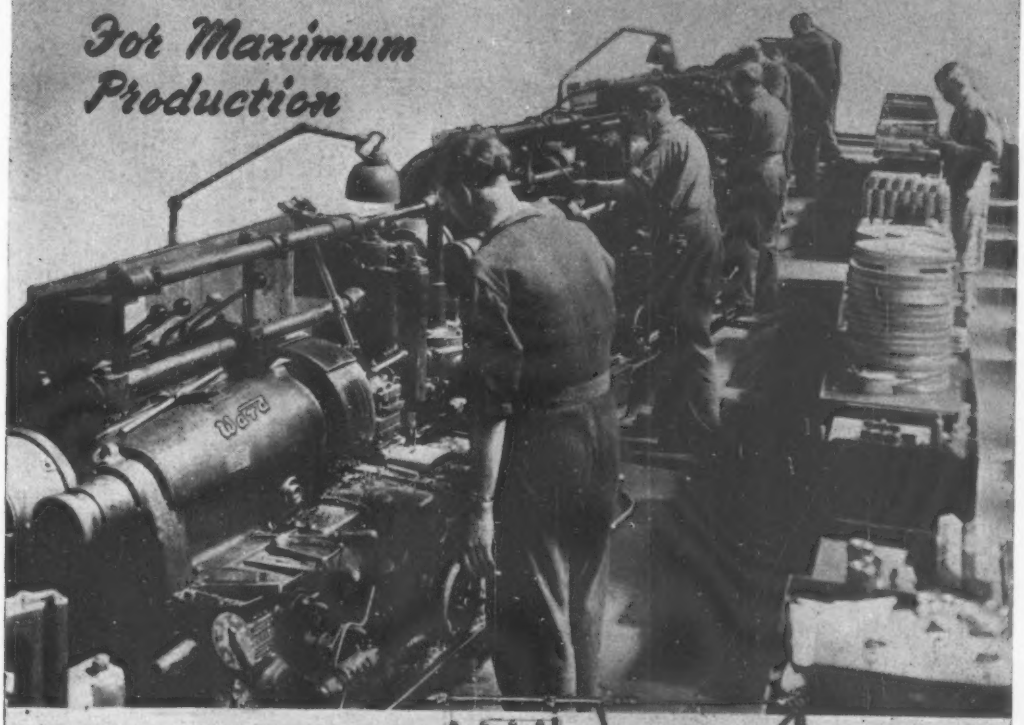
Ward No. 7 COMBINATION TURRET LATHES

For Maximum Production



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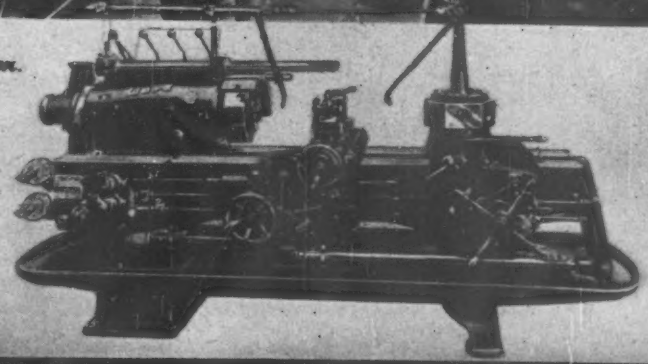

Swing over stainless steel covers . . . . . 16 in.
Swing over saddle up to cross slide . . . . 14½ in.
Diameter of hole through spindle . . . . . 2⅞ in.
Hydraulic actuation of driving clutch giving finger tip gear change.

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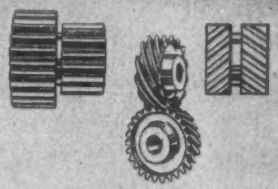

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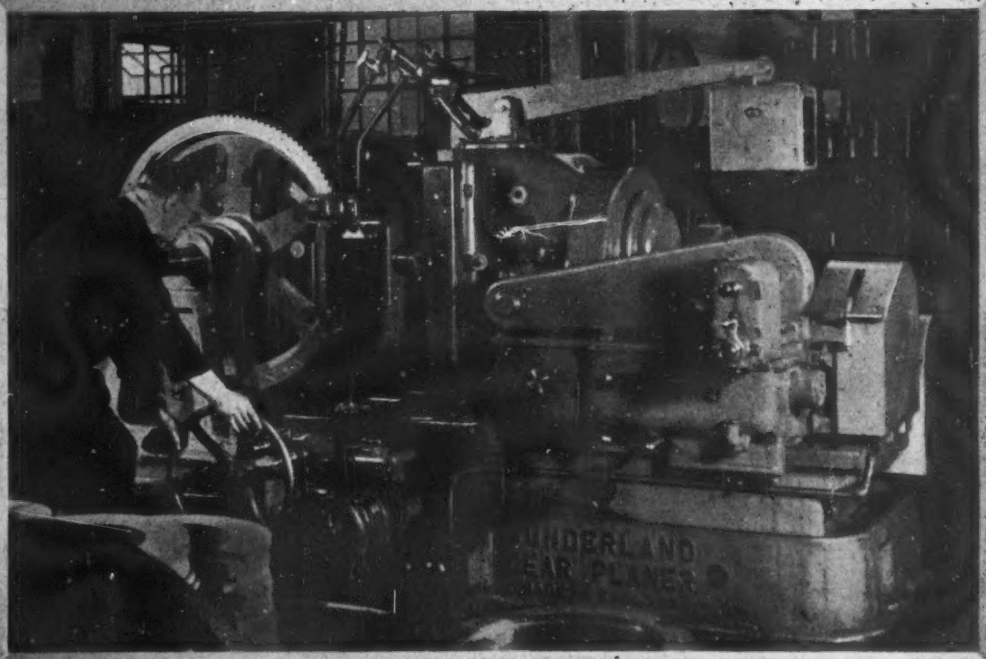

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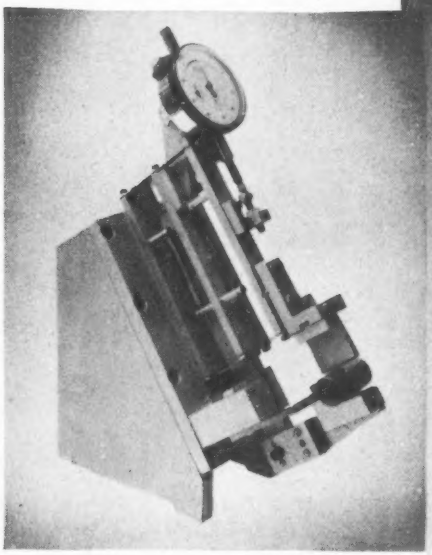
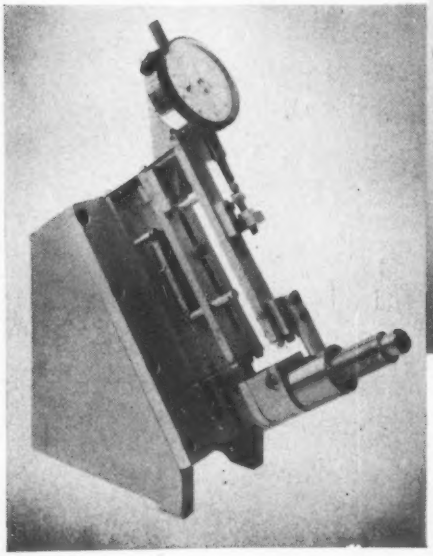
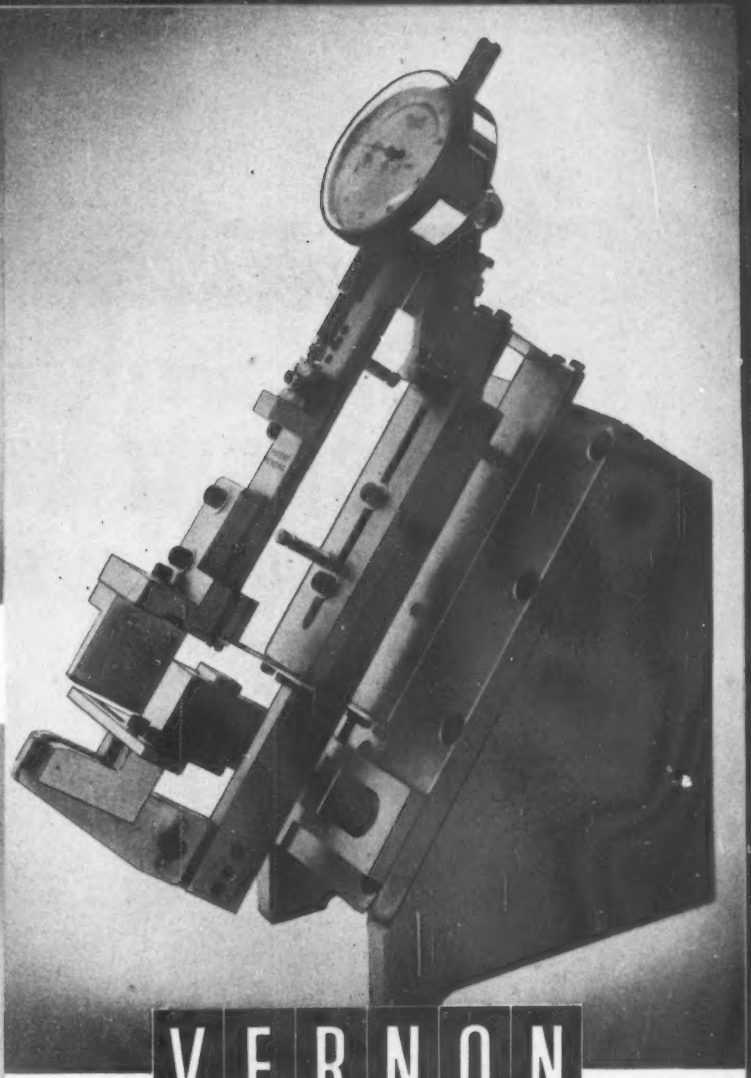


Basic unit arranged to measure outside diameters (above)

Basic unit arranged to measure bore diameter (below)





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- Rapid adjustment. ● Resistant to shock. ● Extreme Accuracy of repeatability and sensitivity.

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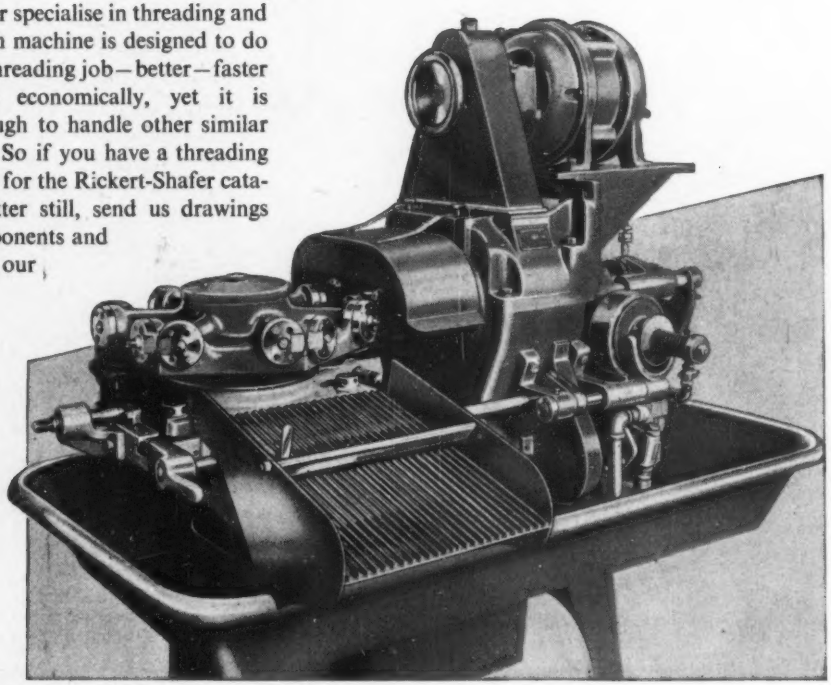

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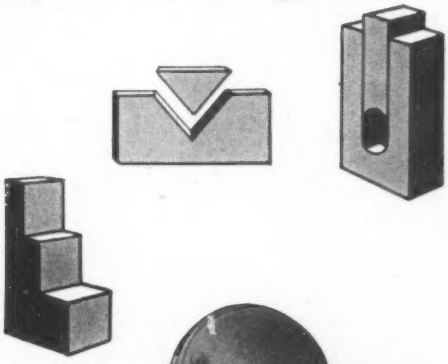
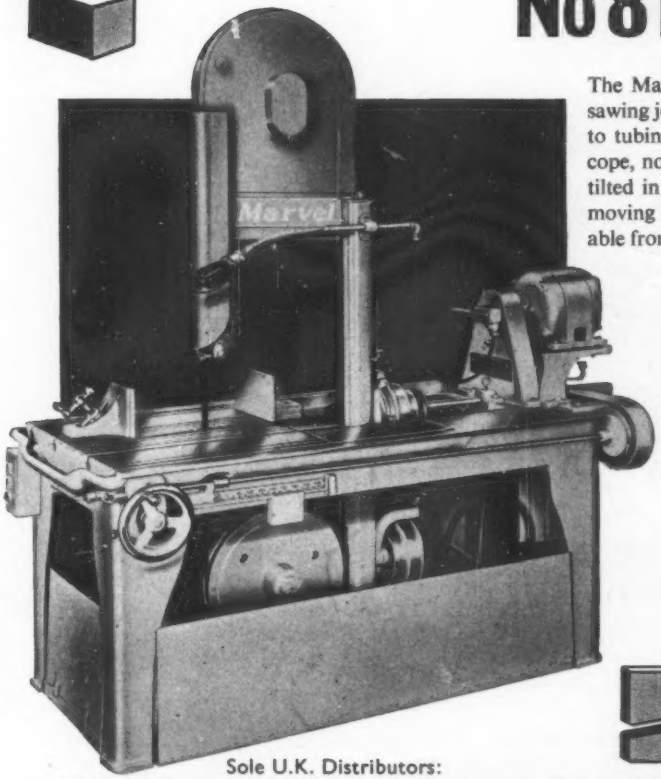


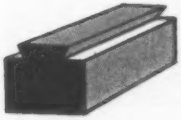
ARMSTRONG-BLUM 'MARVEL' No 8 BAND-SAW



The Marvel No. 8 handles every conceivable sawing job from the smallest and most delicate to tubing, bar and heavy solids. It will slot, cope, notch and the column and blade can be tilted in either direction for mitring without moving the work. The feed pressure is adjustable from a few ounces to 80 lb. and adjustable feed stops and quick approach and return are provided. 3 Blade speeds: 80 to 200 ft. per min.; or 6 speeds: 40 to 200 ft. per min.

CAPACITY 18" x 18" or 24" x 18"

Also the No. 24 Hack Saw for rolling mills, forges and stockholders.



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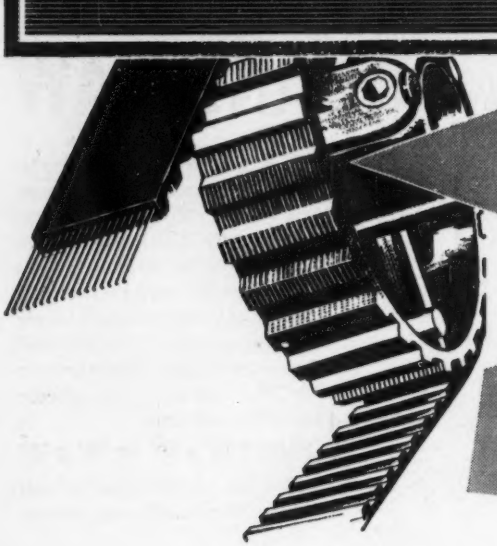

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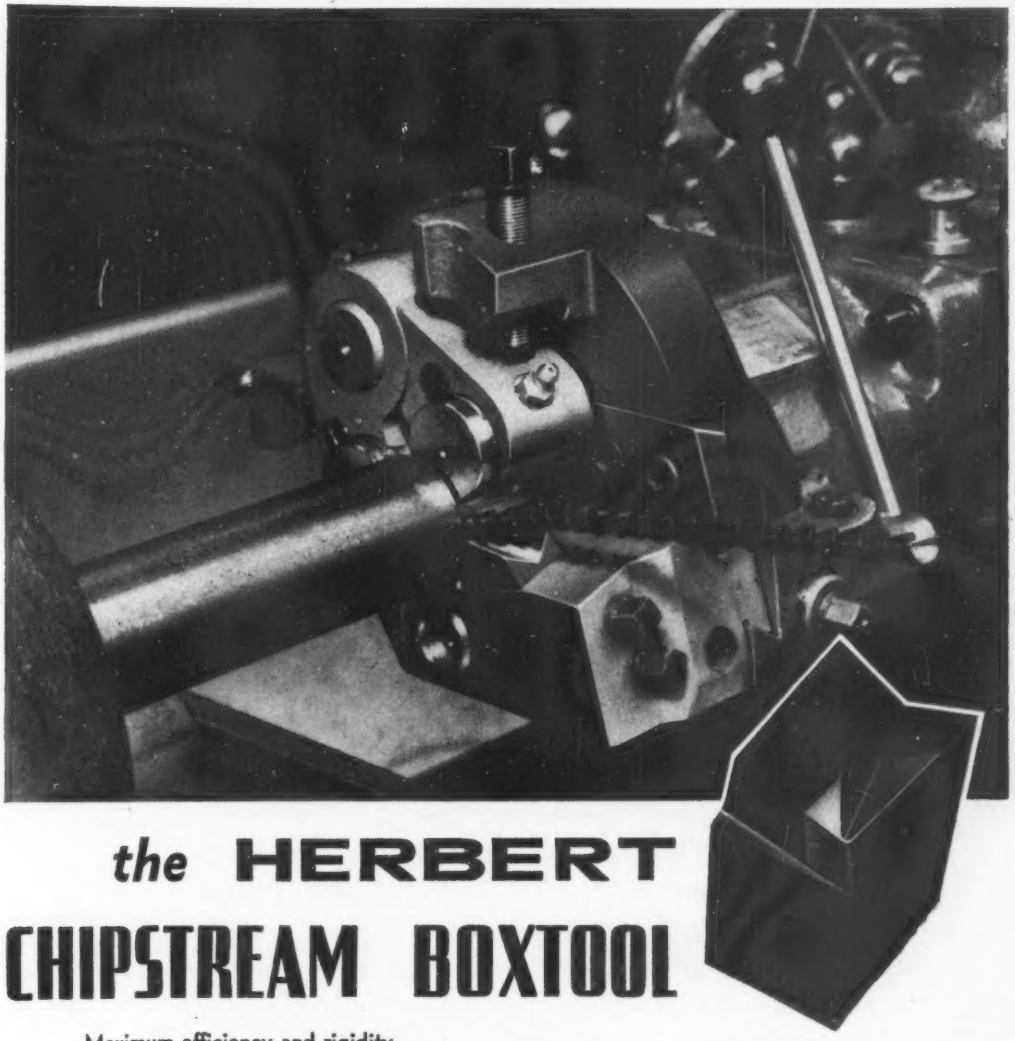

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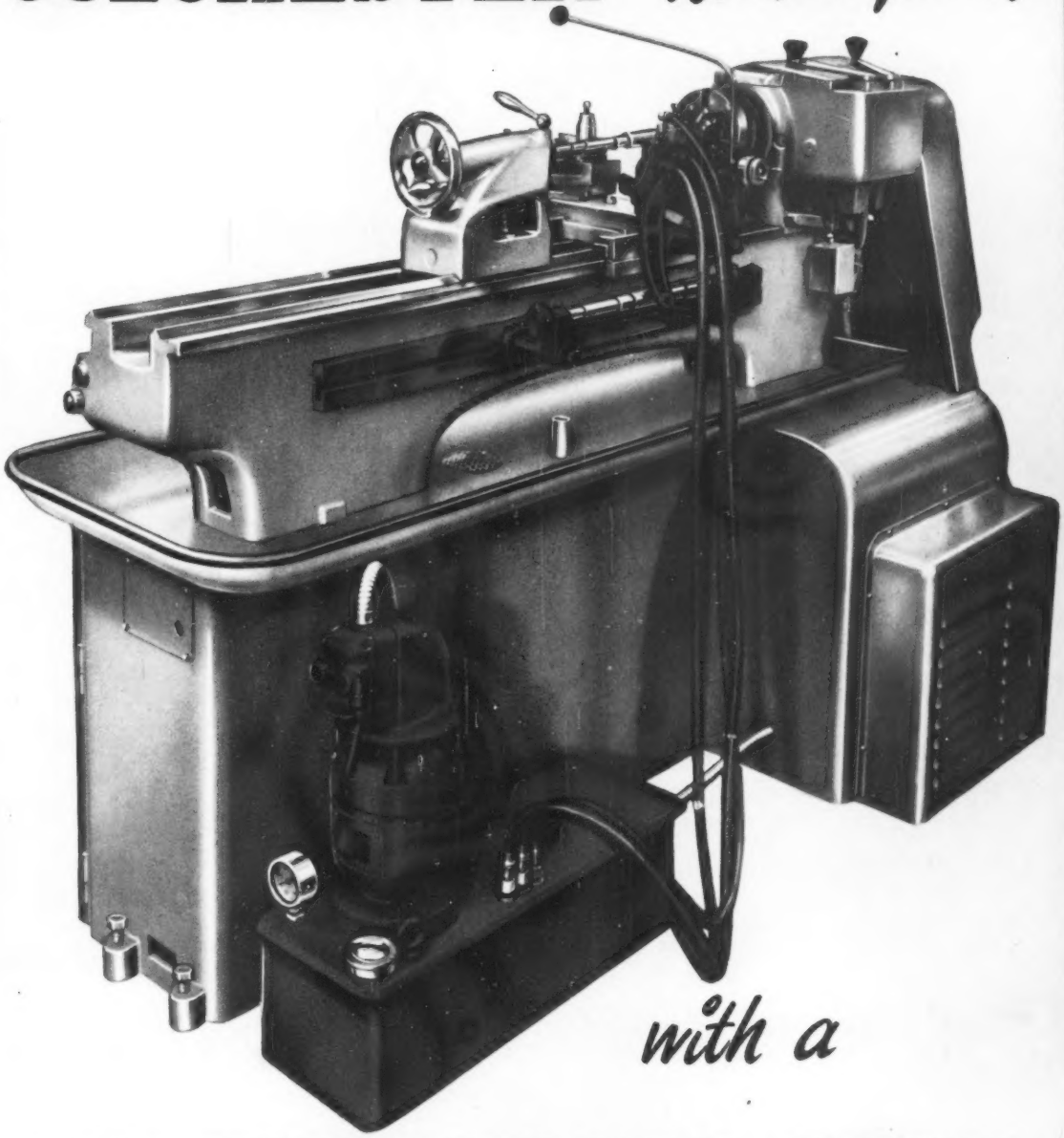

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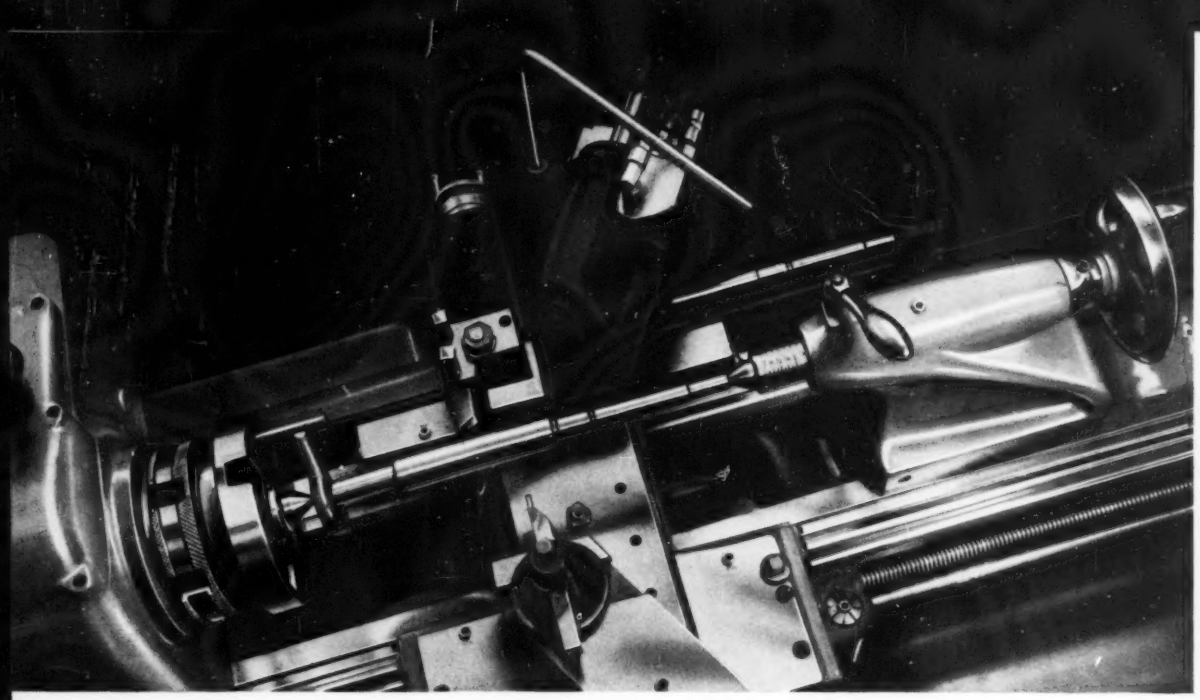
See over for details and price . . . .



- ★ LOW PRICE COUPLED WITH GREAT ACCURACY.
- ★ CONSISTS OF THREE BASIC FULLY INTERCHANGEABLE ASSEMBLIES.
- ★ IDEAL FOR MACHINING SLOW TAPERS, ETC.
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- ★ DOES NOT IMPEDE USE OF MACHINE AS NORMAL LATHE.

This new hydraulic copying attachment is the most reasonably priced attachment yet offered, and models are available for use with the following 'COLCHESTER LATHES': 5" CHIPMASTER, 6" STUDENT, 6½" MASTER. Additional models for use with the TRIUMPH AND MASCOT LATHES will be available shortly.

Mounted directly onto the rear of the cross slide, the unit incorporates a potentiometric rather than the more conventional zero-lap type of hydraulic tracer valve. This avoids many of the troubles associated with zero-lap valves. Slow tapers can be turned accurately and with confidence. The unit can also be used for taper turning, boring and facing on chucked components, taper threading, and threading of components up to a shoulder without the necessity of an undercut.

Three assemblies are linked to form the complete unit; the piston and cylinder assembly, the rear beam assembly and the free standing pump unit.

A specially ground and tapped pad is provided on the rear of the bed to accommodate the rear beam assembly consisting of a specially sectioned bar and two tailstock assemblies which carry the circular master between centres; this allows standard parallel masters to be used for taper turning.

The free standing pump unit has a pressure gauge mounted on the top in front of the vertical flange mounted pump motor. Motor switchgear is mounted on top of the motor, and connection between the pump unit and the piston unit is by three standard flexible hoses.

SPECIFICATION

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Max. copying dia.	5 in.
Max. copying length	24 in.
Max. depth of profile in one setting	3 in.
Max. Front angle	5° undercut
Max. Back angle	30°
H.P. Hydraulic Pump Motor	½

STUDENT LATHE

Swing over bed	12 in.
Swing over carriage	9 in.
Swing in gap	19 in.
Length of gap	4⅛ in.
Hole through spindle	1 5/16 in. dia.
Eight Spindle Speeds	45/1,000 r.p.m.
Distance between centres	24 in.
Motor	1½ H.P.

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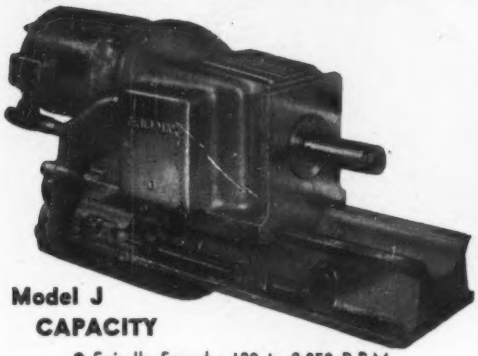
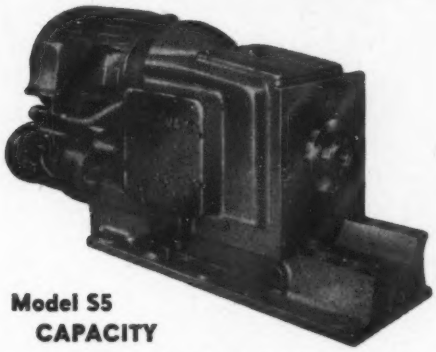


Model J
CAPACITY

- Spindle Speeds: 120 to 2,850 R.P.M.
- Feed Range (Drilling or Tapping) 0·0022 to 0·110 per rev.
- 1 H.P. Main Motor
- 9in. Max. Standard Stroke
- Morse Taper or Multi-Head Spindle Nose

Model 2S
CAPACITY

- Spindle Speeds: 41 to 2,000 R.P.M.
- Feed Range (Drilling or Tapping) 0·0022 to 0·110 per rev.
- 1½ to 3 H.P. Main Motor
- 6in. or 12in. Standard Stroke
- 2⅜in. Milling Machine Type Spindle Nose



Model S5
CAPACITY

- Spindle Speeds: 41 to 1,500 R.P.M.
- Feed Range (Drilling or Tapping) 0·0022 to 0·110 per rev.
- 3 to 7½ H.P. Main Motor
- 9in. or 15in. Standard Stroke
- 3½in. Milling Machine Type Spindle Nose

Model S15
CAPACITY

- Spindle Speeds: 41 to 750 R.P.M.
- Feed Range (Drilling or Tapping) 0·0022 to 0·110 per rev.
- 10 to 15 H.P. Main Motor
- 12in. or 18in. Standard Stroke
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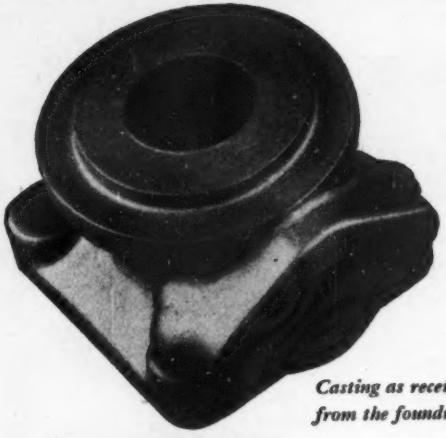
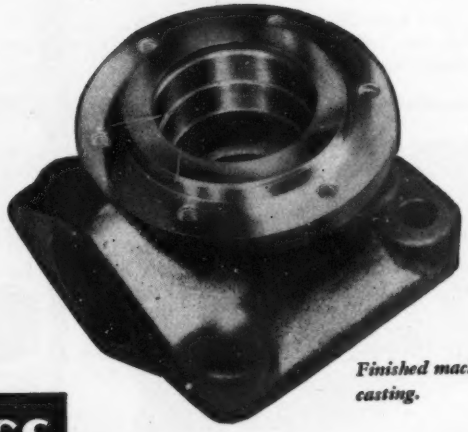
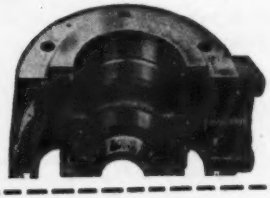


Casting as received from the foundry.



Finished machined casting.

HARPER CASTINGS



Sectioned casting showing the clean cored passages.

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12" x 40" capacity

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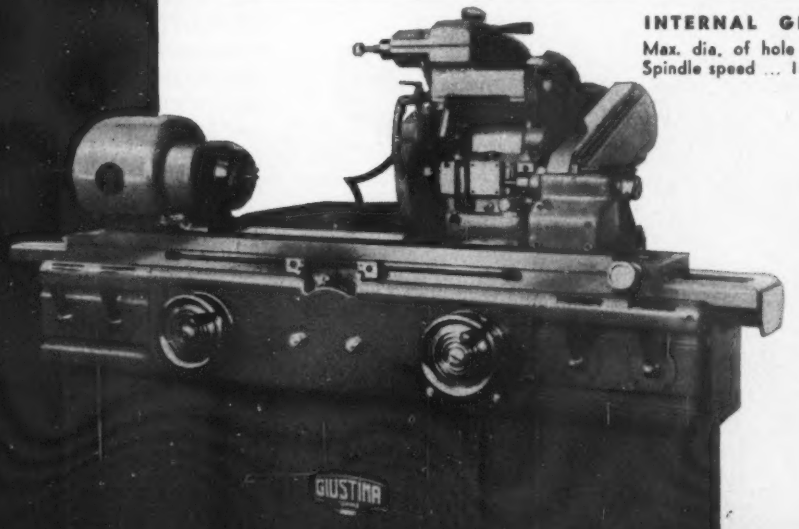
Max. dia. of hole ..... 10"
Spindle speed ... 18,000 r.p.m.



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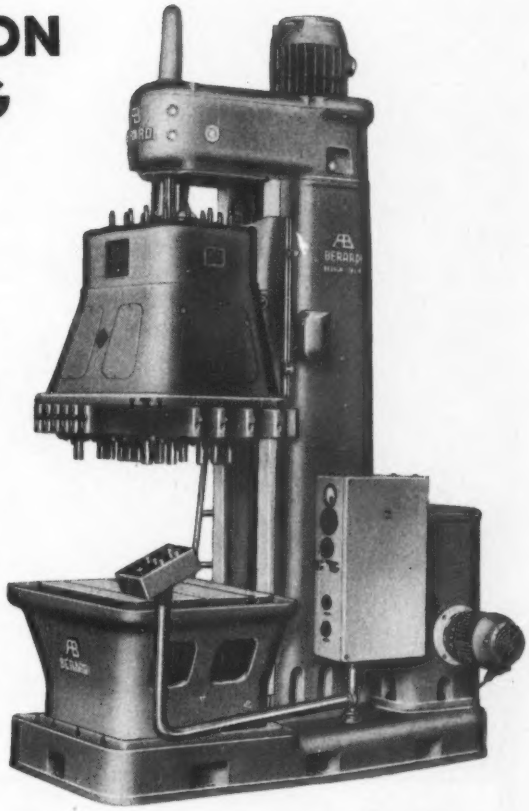

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Upright, multiple and adjustable spindle Drilling machine, fitted with hydraulically controlled head and automatic work cycle.

Available with various types of rectangular or round cluster heads with adjustable bracket type or fixed spindles. Six types of work table in standard execution supplied.

MAIN CHARACTERISTICS

Total number of spindles	16 or 24
Drilling capacity for each single spindle	1¼" or ⅞"
Max. area of drilling	25⅝" x 16" or 20" diameter
No. of spindle speeds with single gear change	12
Range of stepless variable feeds	¾" to 17½"/min.
Total power required	16 H.P.
Feed thrust	4½ tons
Weight of machines	5 tons

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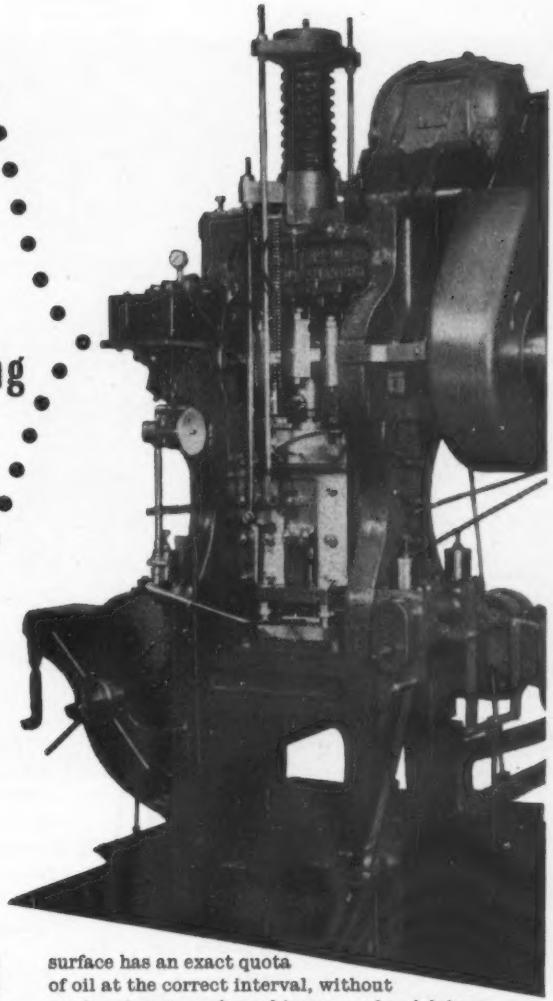
Tecalemit automatic lubrication safeguards every bearing on this press



This Cutting and Cupping Press with double roll feed made by Messrs. Taylor & Challen Ltd., Derwent Works, Birmingham, is fitted with a "Tecalemit-Bijur" High Pressure Pump, Type "A". Oil is supplied at the required intervals to all bearings—up to 100 may be supplied.

Action is entirely automatic, being controlled by a positively driven cam unit. This feeds calibrated metering valves at all oiling points.

A "Tecalemit-Bijur" Automatic Lubrication System ensures that every bearing and working surface has an exact quota of oil at the correct interval, without waste, stoppage of machinery, or hand labour. It can be fitted to every type of machine, either initially by the manufacturers, or by an actual user. Fitting is not complicated and the many advantages in labour saving, time saving, and smooth efficient working, soon offset the moderate initial cost.

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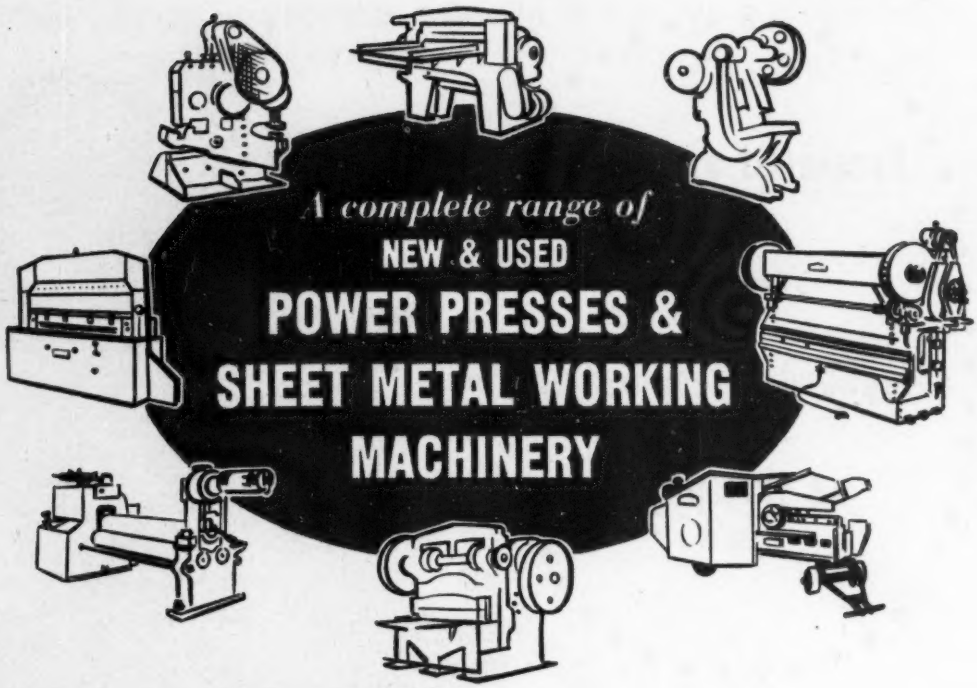

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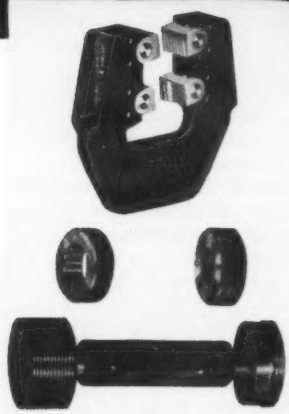

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All the most important developments in gauge design have been built into the Horstmann Model 52 Screw Caliper Gauge, making it the finest instrument of its type. There are many special features: the anvils are set so that they do not roll—all shearing action is eliminated—the caliper is suitable for either left- or right-hand threads—it is ideal for gauging Acme forms and shouldered work—and simple adjustment allows not only for a wide range of work diameters and tolerances, but enables the gauge after long usage to be re-adjusted many times to size so that the necessity for regrinding is eliminated. Model 52 is normally supplied as a 'GO'/'NOT GO' combination so that both tests can be applied in one action, but it is also available as 'GO' only or 'NOT GO' only. It is made in a full range of B.A., American, Unified, Whitworth and Metric forms of thread. This is an instrument on which you can rely for fine accuracy, versatility, long life and ease of operation.

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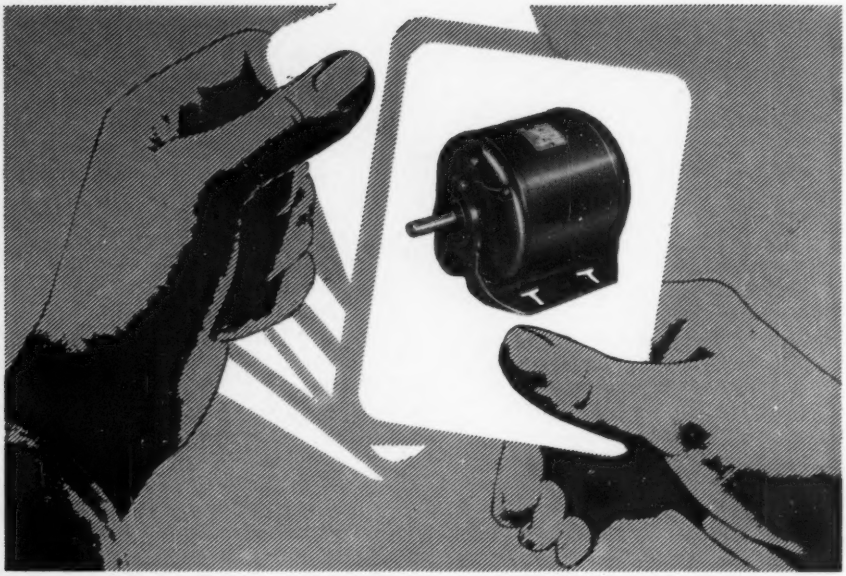

An entirely new suit in F.H.P. motors

You cannot interfere with a production line every time a new idea or a possible improvement to the product turns up. You have to let these ideas accumulate and then, in one clean sweep, incorporate the lot—or as many as are compatible—in a new design.

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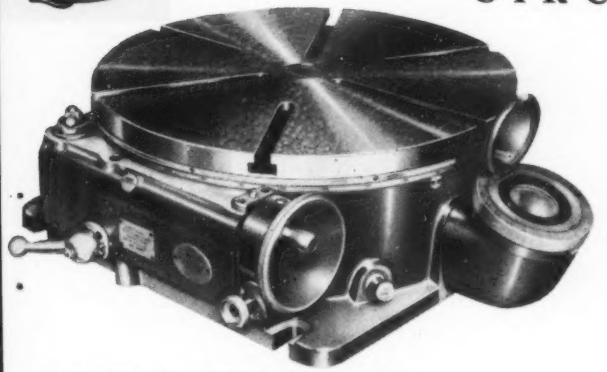

MATRIX 12″ CIRCULAR TABLE

Designed for use on small jig boring machines and light milling machines as well as for inspection purposes. Table readings direct to one minute of arc and five seconds by vernier. Diameter of table 12″ (300 m.m.). Total overall height 3¼″ (80 m.m.). Send for Catalogue Ref. C.T.

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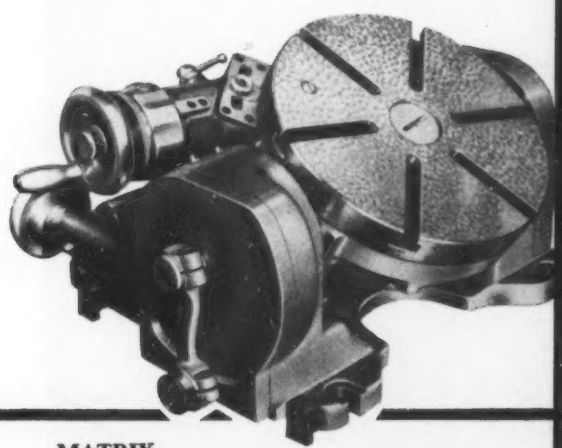

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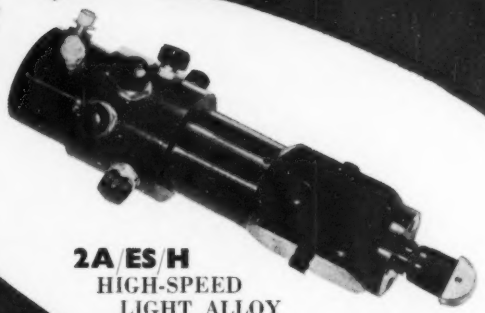

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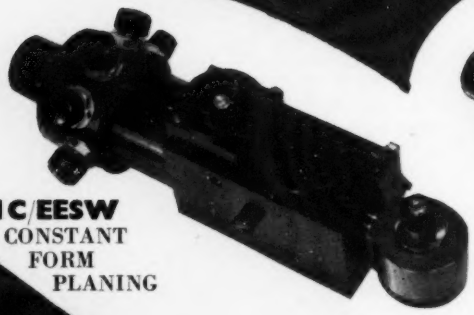

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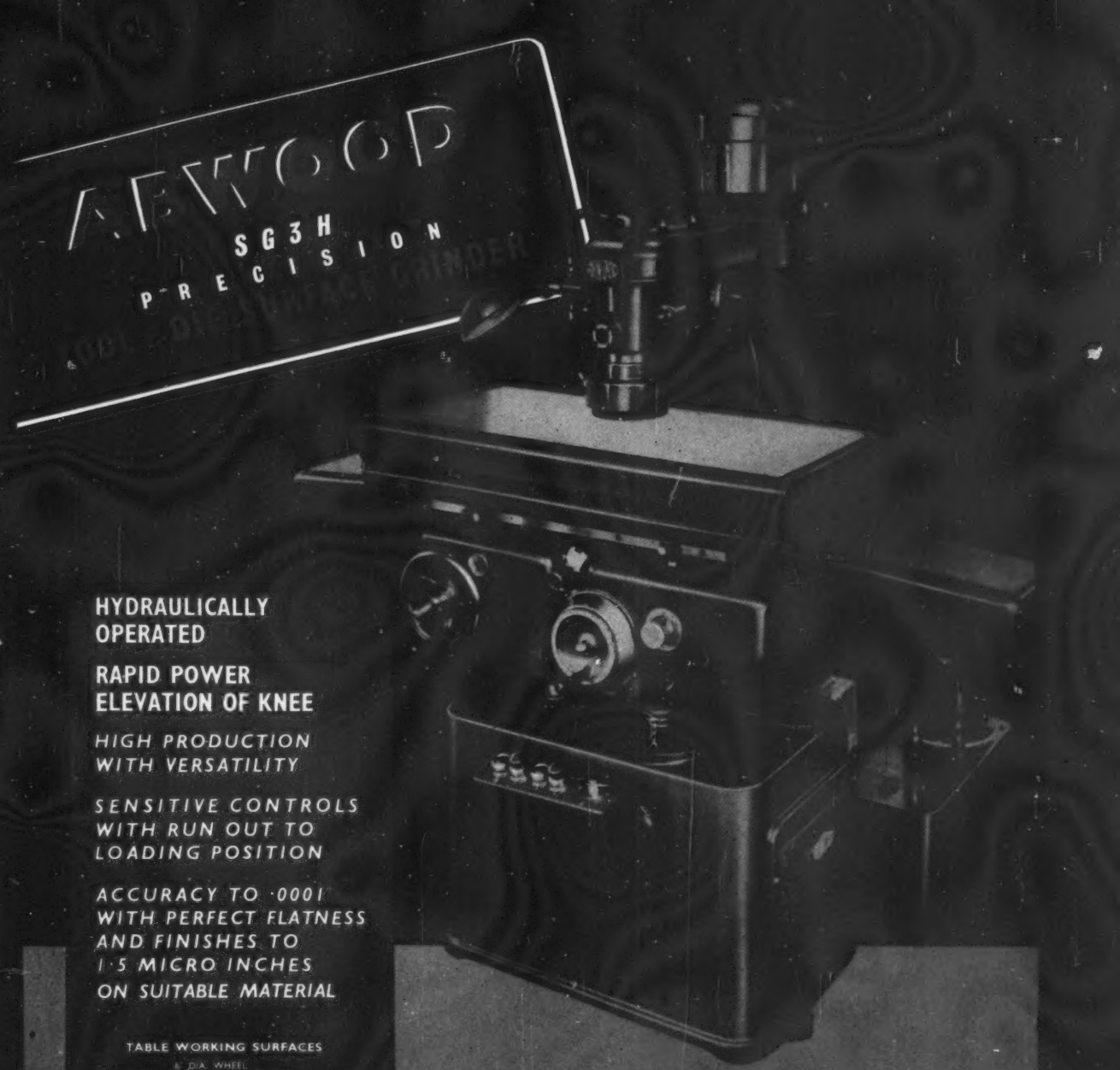

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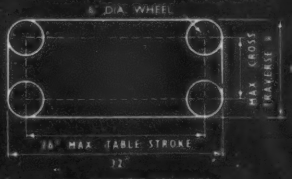

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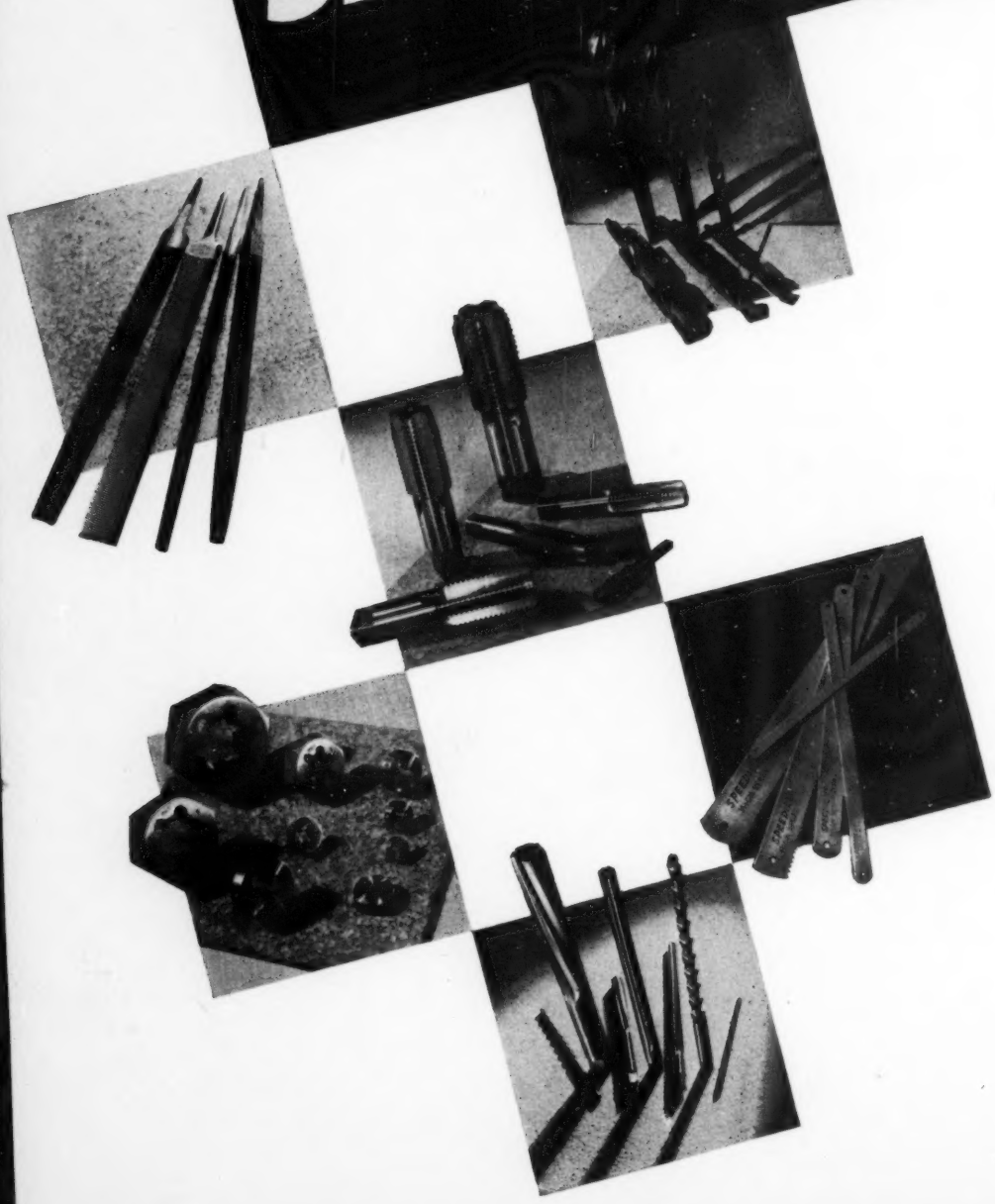

Our customer produces Iron Pipe fittings. Normal tap life when machine tapping was only 40/50 components. A Technical Representative from Speedicut Works studied the problem and made recommendations on design and treatment which increased tap life on this operation to over 1,500 components.

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SPEEDICUT WORKS, CARLISLE STREET EAST,
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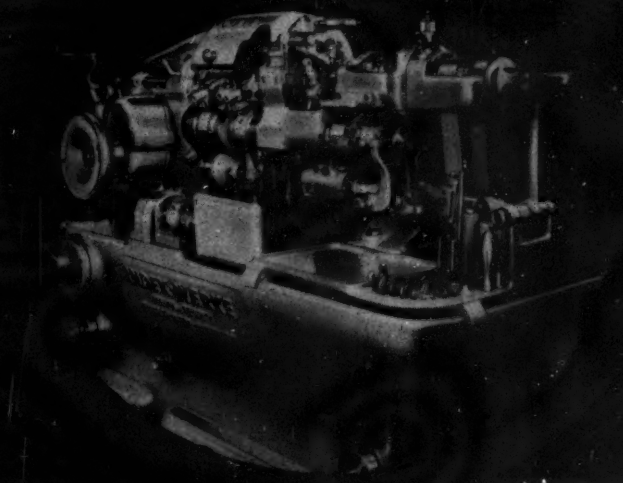
INDEX ON HIGH SPEED AUTOMATIC



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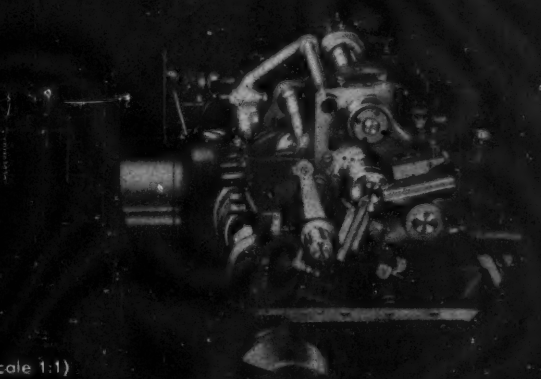
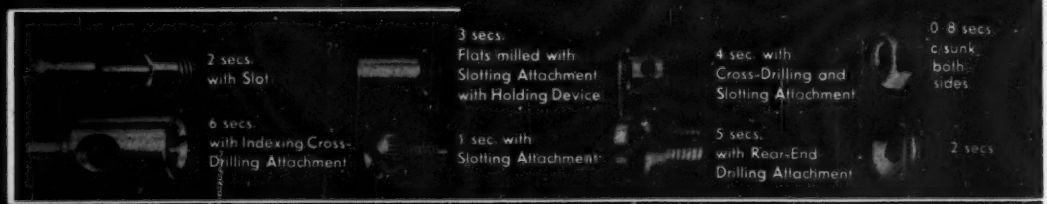


A few examples illustrating the production capabilities of this automatic. (Mat.: Brass, Scale 1:1)


2 secs. with Slot
6 secs. with Indexing Cross-Drilling Attachment
3 secs. Flats milled with Slotting Attachment with Holding Device
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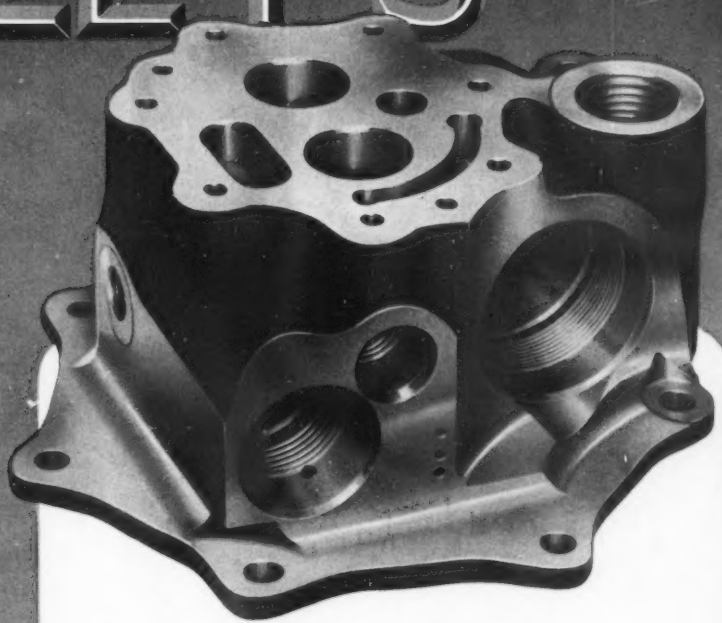

Tested at 2,500 p.s.i.

The illustration shows a valve body for use in hydraulic control equipment. The complex nature of this valve body involves a great deal of machining; at the same time high mechanical strength is an important factor, since the valves are used at a high working pressure and are tested at 2,500 p.s.i.

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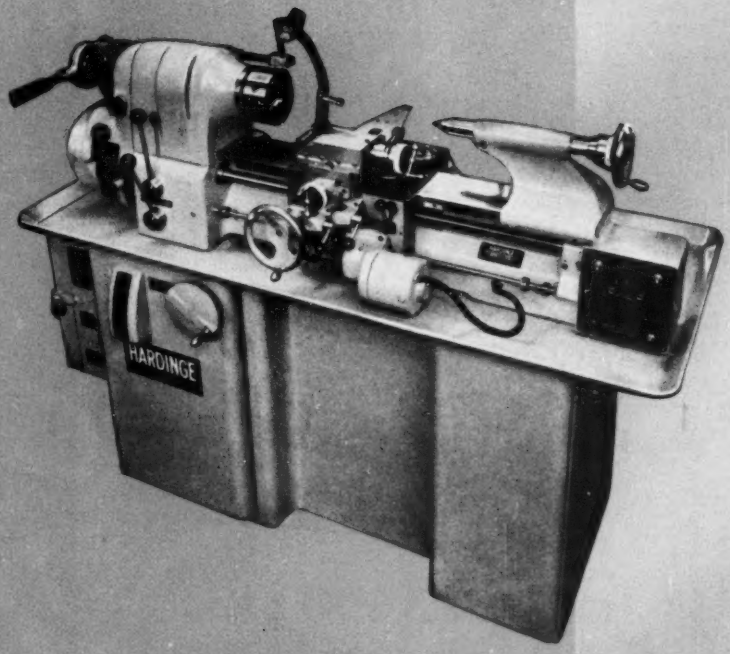

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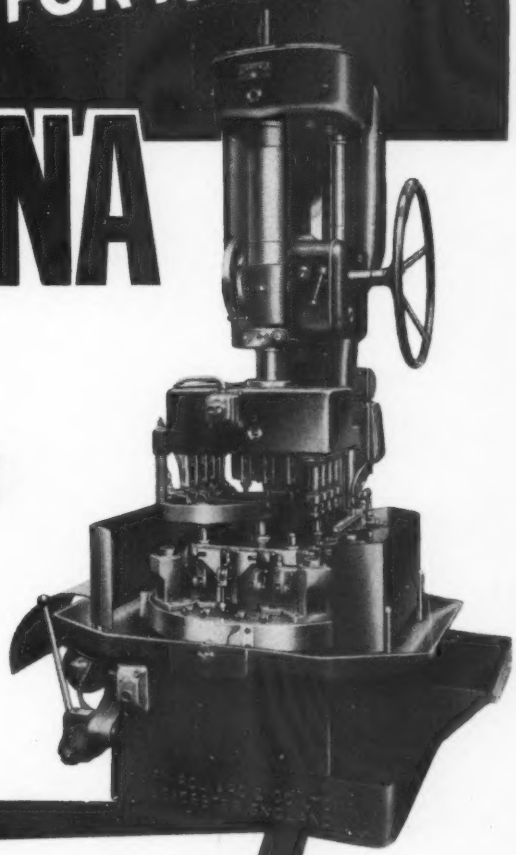

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HAND OR MECHANICAL INDEXING TABLES.
RACK OR CAM FEED TO MULTIPLE HEAD.

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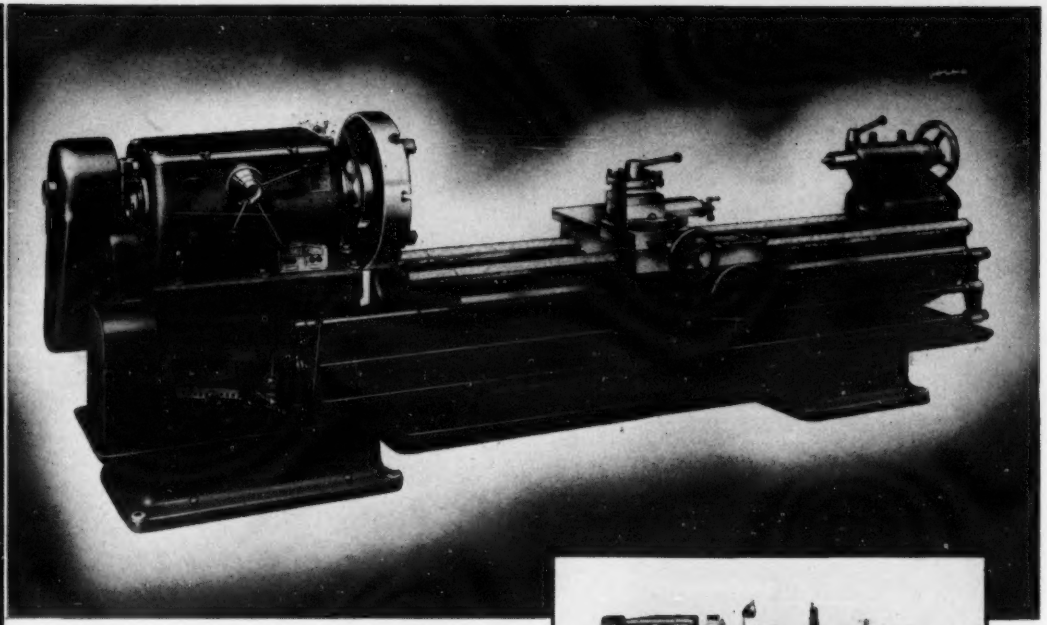

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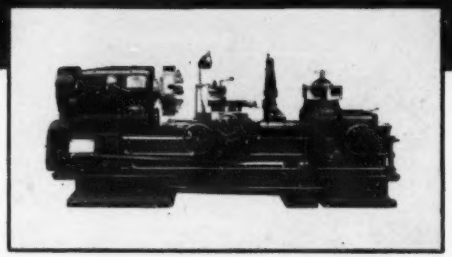

12½" centre lathe fitted with hexagon turret on separate power operated carriage.

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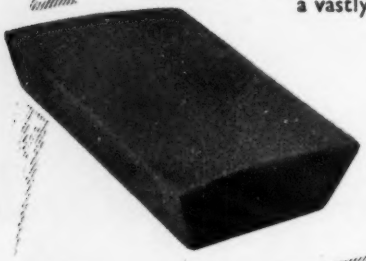

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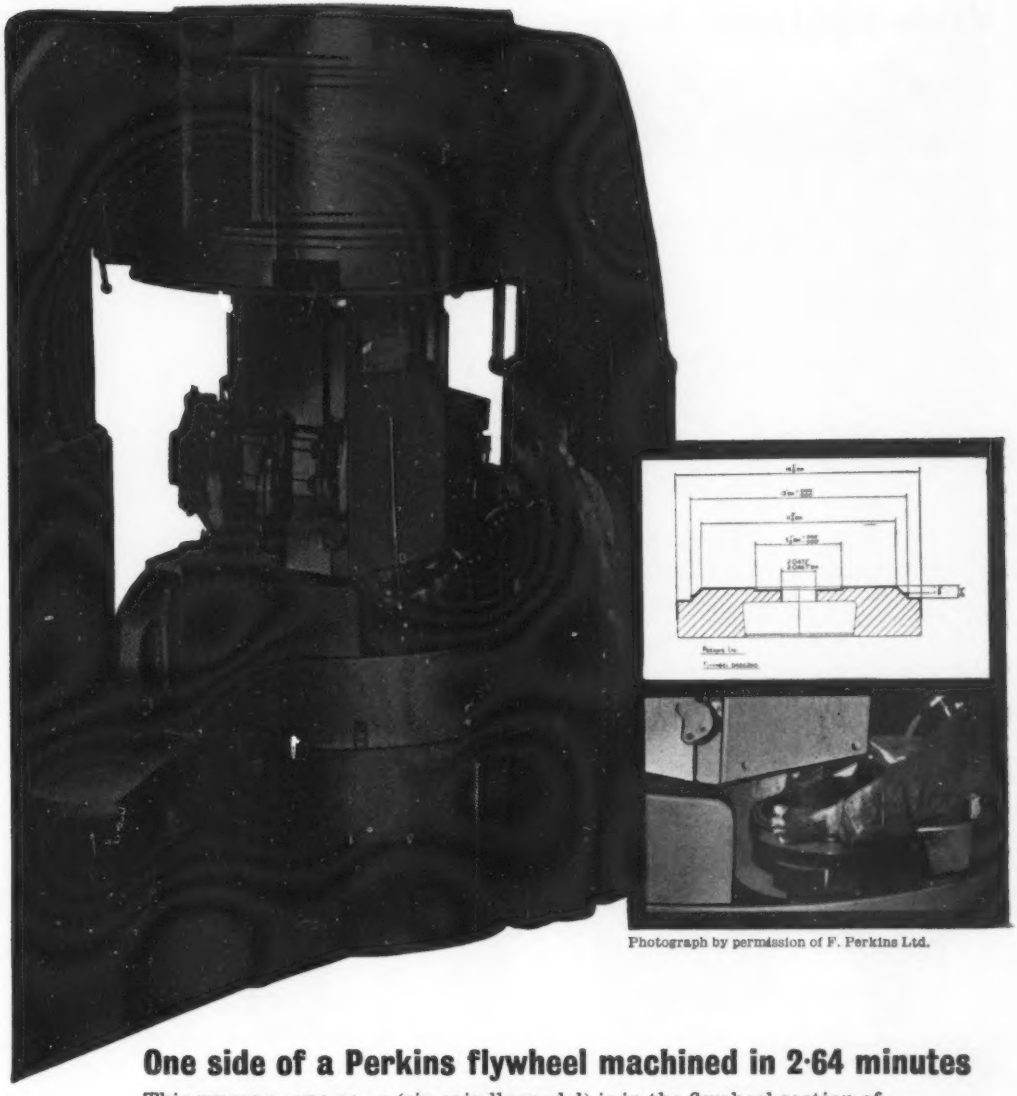

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One side of a Perkins flywheel machined in 2·64 minutes

This VERTICALAUTO NO. 10 (six-spindle model) is in the flywheel section of F. Perkins Ltd., Peterborough. It maintains a bore tolerance of ·0007", and crankshaft register and starter ring diameters are held within ·002" and ·0015" respectively. There are nine tooling positions and the six 16" hydraulically operated chucks are driven by a 60 h.p. main motor. Eight- and twelve-spindle machines are also available.

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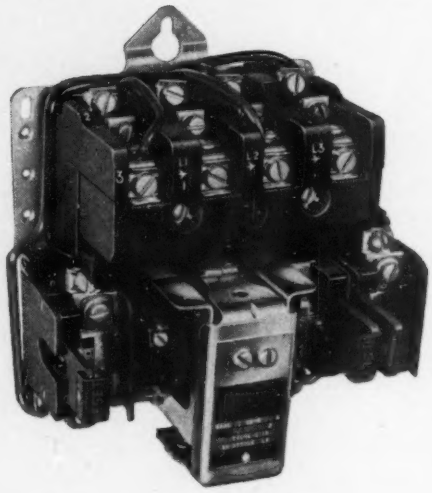
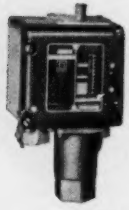
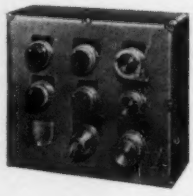


Starters and Contactors for motors up to 100 H.P.



Pressure Switches with ranges up to 3,000 p.s.i. Hydraulic and Pneumatic. All settings adjustable.



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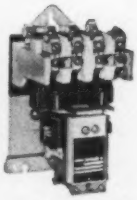

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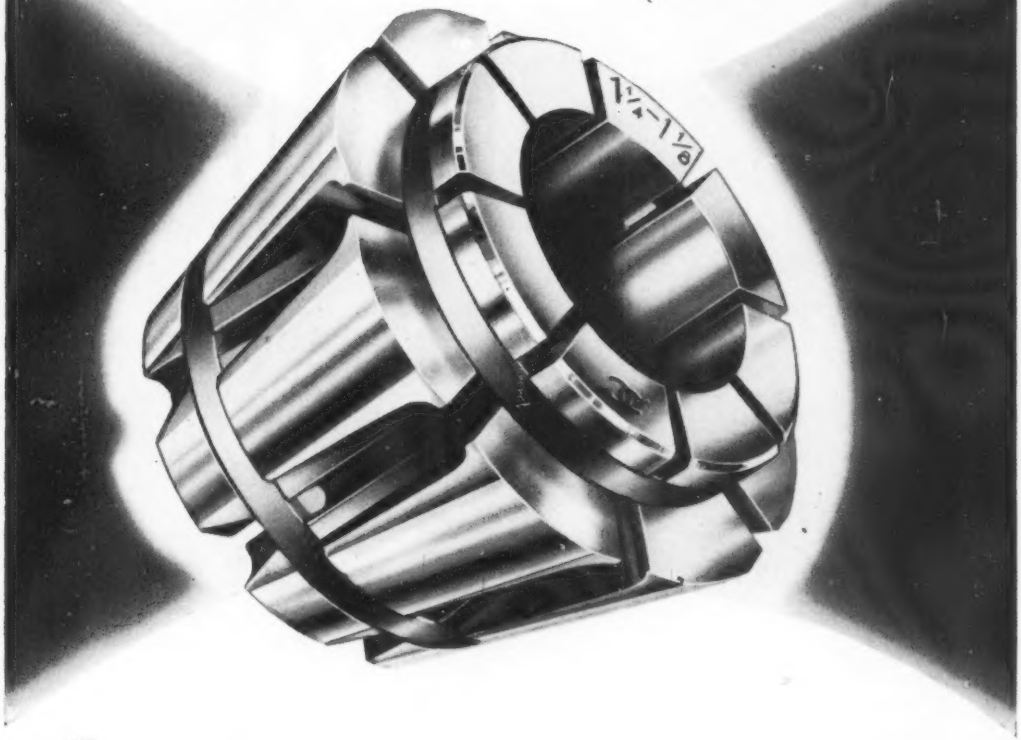

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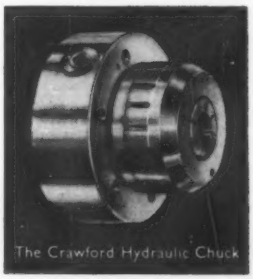
Adjustable to any diameter within its ⅛in. limits, each Multibore collet replaces at least ten conventional collets. Thus a very small range of Multibore collets will handle all sizes of work between ⅛in. and 2in. The Crawford Hydraulic Chuck is specially designed for use with Multibore collets, and will be available in two sizes. Each incorporates a self-contained hydraulic system, for closing the collet easily and efficiently, making this the most powerful DEAD LENGTH chuck in the world.


The Crawford Hydraulic Chuck

CRAWFORD COLLETS LIMITED

WITNEY · OXON *Telephone: Witney 334*

London Stockists: Acbars Limited, 16-18, Macleod Street, Walworth Road, London, S.E.17. RODney 7191.
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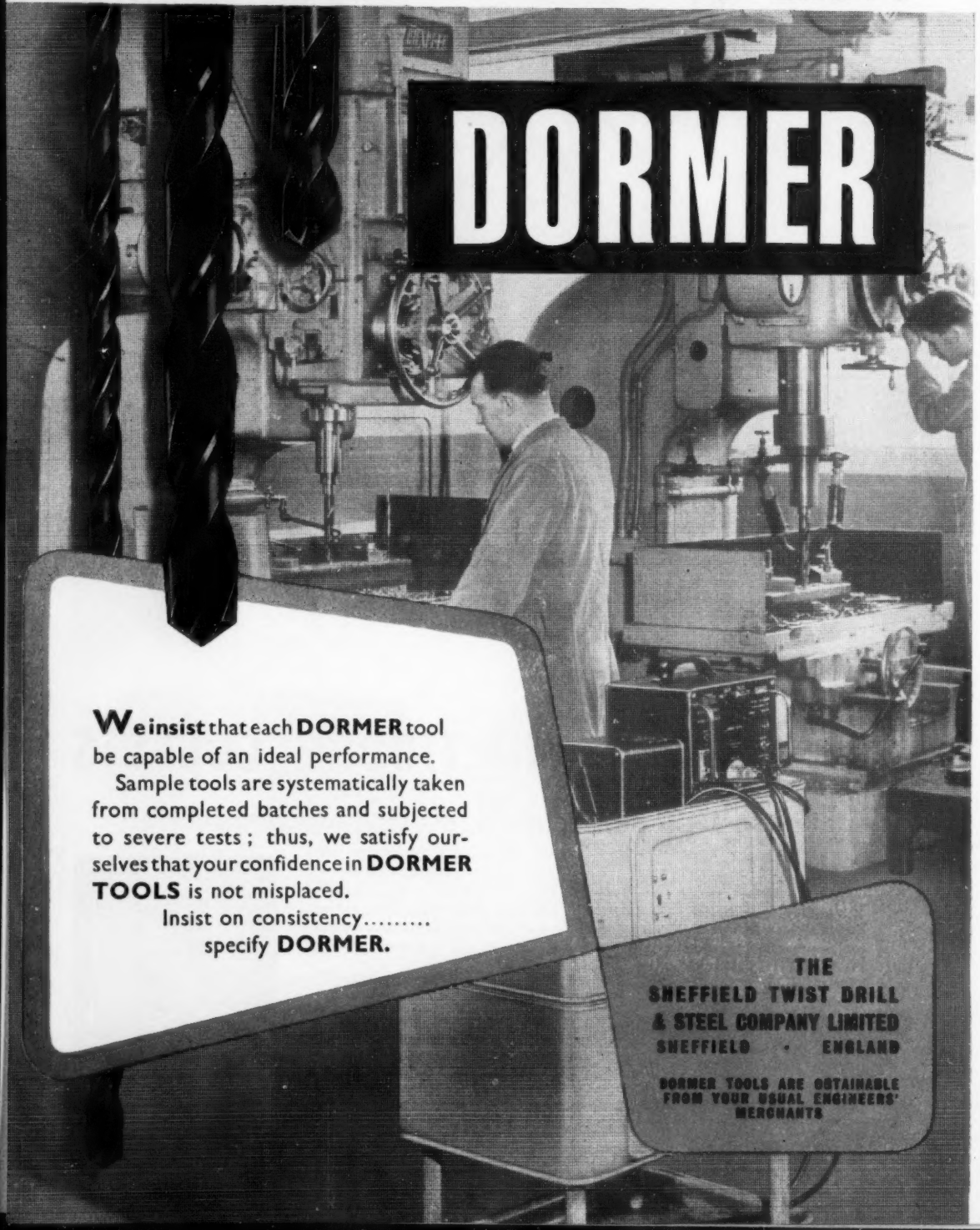

We insist that each **DORMER** tool be capable of an ideal performance.

Sample tools are systematically taken from completed batches and subjected to severe tests; thus, we satisfy ourselves that your confidence in **DORMER TOOLS** is not misplaced.

Insist on consistency.....
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★ROSA JIG BORER

MODEL 35 ALZ

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THE MOST INEXPENSIVE HIGH PRECISION MACHINE OF ITS CAPACITY FINISH AND QUALITY EVER PRODUCED!!!

Infinitely variable speeds. Power rise and fall to head with foolproof stops for automatic up and down feeds. Portable foot control switch for inching of spindle. Totally enclosed Lead Screws.

TABLE 35½" by 12½"

Table Travel Longit.	19¾"
Table Travel Cross	12½"
Spindle Nose to Table	23⅜"
Sliding Head Travel	19 11/16"
Drilling Capacity in Steel	1 7/16"
Boring Capacity in Steel	5⅞"
Spindle speed - R.P.M.	70-1300
Spindle Feeds	4
Table Position in Accuracy	0·0002"

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MADE BY THE WORLD FAMED MANUFACTURERS OF ROSA HIGH PRECISION DRILLING MACHINES. OVER 50 YEARS' EXPERIENCE.

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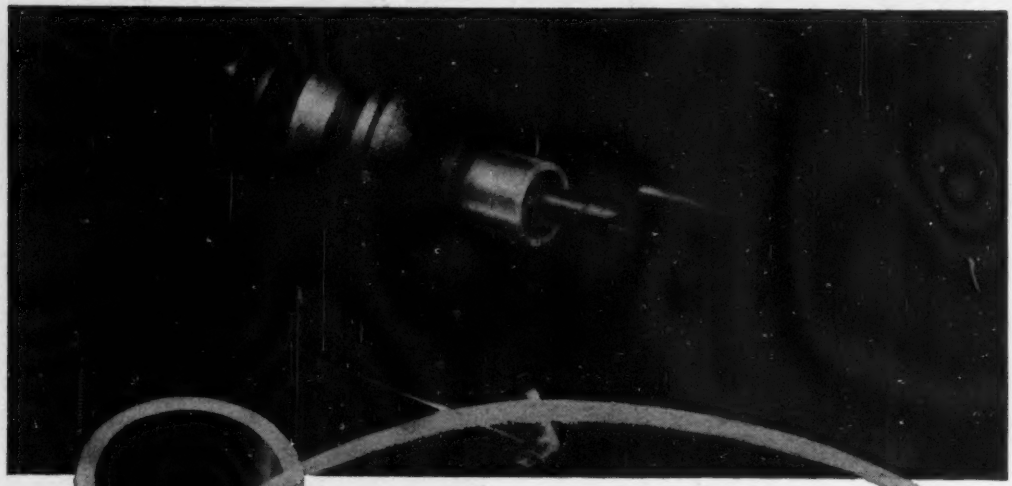
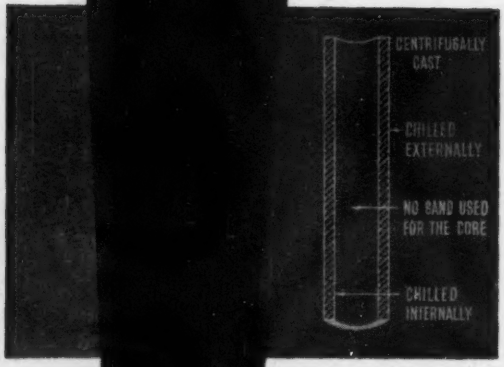


It's the Spunchilled bore that counts



FOR HIGH CLASS BEARING BUSHES.

Holfos Spuncast Bronze tubes possess the additional qualities which make all the difference between something ordinary and something good.

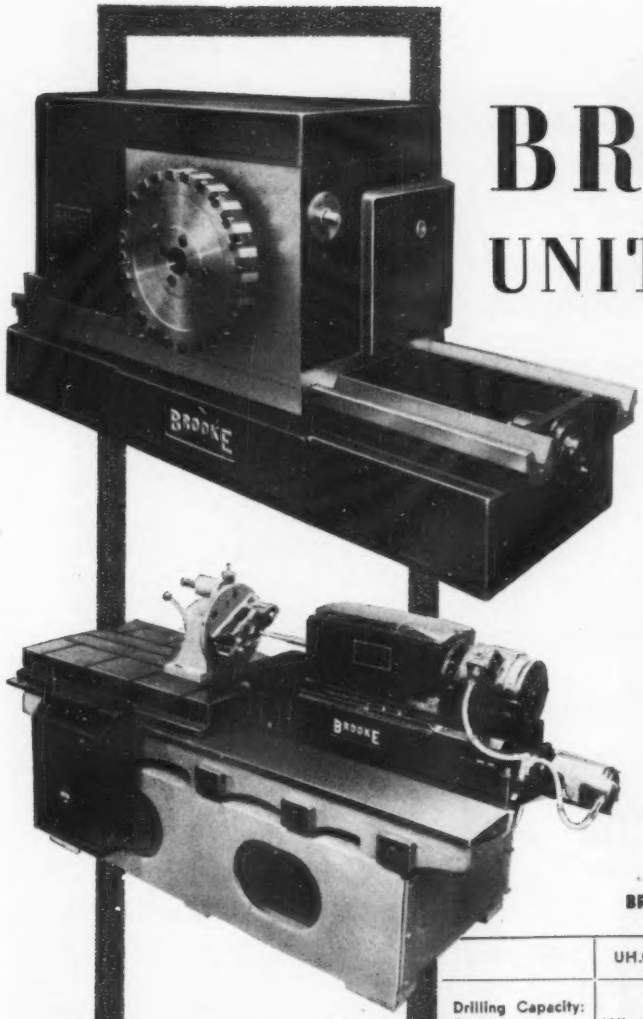
The absence of sand in association with the chilling of the bore by special process means that the inside of the tube is clean, true and sound.

The whole process of Holfos Spuncast production ensures accuracy, concentricity and a good surface finish on both the inside and outside diameters of Holfos tubes.

These qualities give you the very practical advantage of saving your costs by reduced machining allowances.

SPUNCAST Bronze

JOHN HOLROYD & CO., LTD. HOLFOS WORKS, ROCHDALE, LANCS.



BROOKE
UNIT HEADS

Electro-mechanically operated, the screw feed type Brooke Unit Heads can be used for—drilling, reaming, boring, milling, turning, tapping, spot facing and counter-boring.

The operating cycle is automatic.

The range comprises models: UH.0, UH.1, UH.2, UH.3, and UH.4. Attachments for specific jobs are available as extras.

BRIEF SPECIFICATIONS

	UH.0	UH.1	UH.2	UH.3	UH.4
Drilling Capacity: Cast Iron	$\frac{13}{16}$" dia.	$1\frac{1}{8}$" dia.	2" dia.	3" dia.	4" dia.
Drilling Capacity: Steel	$\frac{3}{4}$" dia.	$\frac{7}{8}$" dia.	$1\frac{1}{4}$" dia.	$2\frac{1}{4}$" dia.	$3\frac{1}{2}$" dia.
Spindle Speeds R.P.M.	305-2850	98-2900	85-1980	Low 65-220 High 330-1022	Low 55-185 High 277-26
Fast Traverse Rate per min.	133"	181"	136"	136"	134"

Full details are available on request from Distributors.

Selson MACHINE TOOLS

The Selson Machine Tool Co. Ltd

41-45 MINERVA ROAD, NORTH ACTON, LONDON, N.W.10

Tel: ELGar 4000 (10 lines) Grams: Selsomachi, London, N.W.10

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D2

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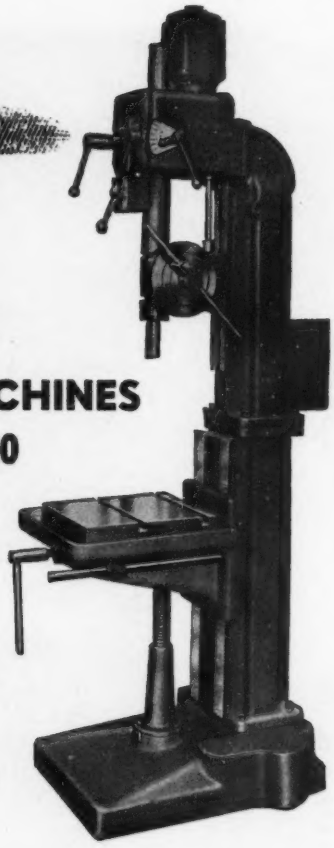
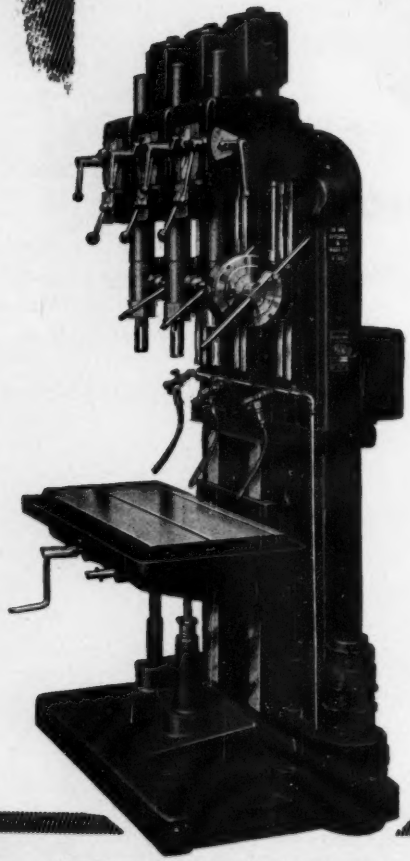
High production

DRILLING MACHINES
TYPE V 20





. . . SINGLE MACHINES OR MULTI-HEAD MACHINES WITH 2, 3, 4 OR 6 SPINDLES

Drilling capacity 1" diameter in mild steel. Standard machine has nine spindle speeds, through gear box, with constant speed motor drive. Many extra features available.

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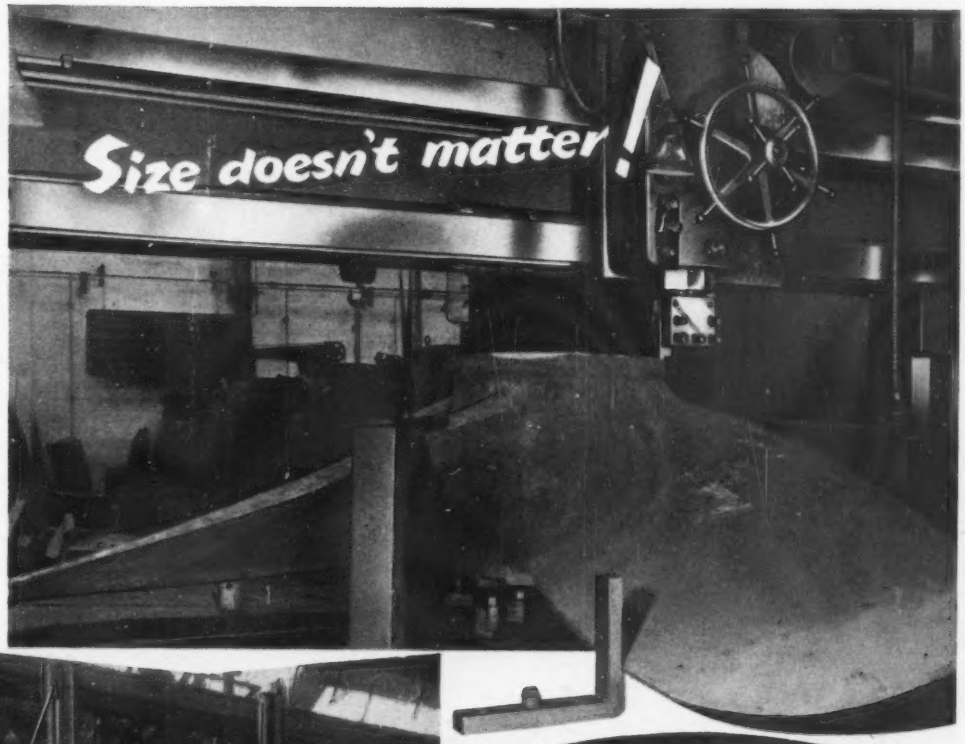

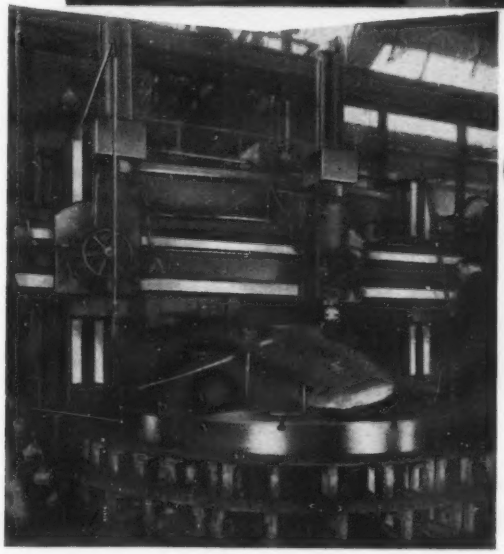

RICHARDS

14 ft.
BORING & TURNING MILL

FACING & TAPER BORING 13 ft. MARINE PROPELLERS at North British Steel Foundry Ltd.

This big RICHARDS boring and turning mill takes the machining of 13 ft. stainless steel propellers in its stride. Operations including facing, taper boring and slotting. Cemented carbide tools are used to full advantage and limits are maintained within 0.001". Table diameter is 13ft. 6in., with a maximum height under cross slide of 6ft. 10in. Down feed of heads—4ft. 0in.

The RICHARDS range extends from 4 ft. to 50 ft. diameter, and we will gladly send you full details.

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Four-Way Tapping Machine

for cutting four threads simultaneously in zinc die castings for THE NORGREN SPRAY-LUBE SYSTEM

DESIGNED AND BUILT FROM STANDARD MACHINE PARTS BY

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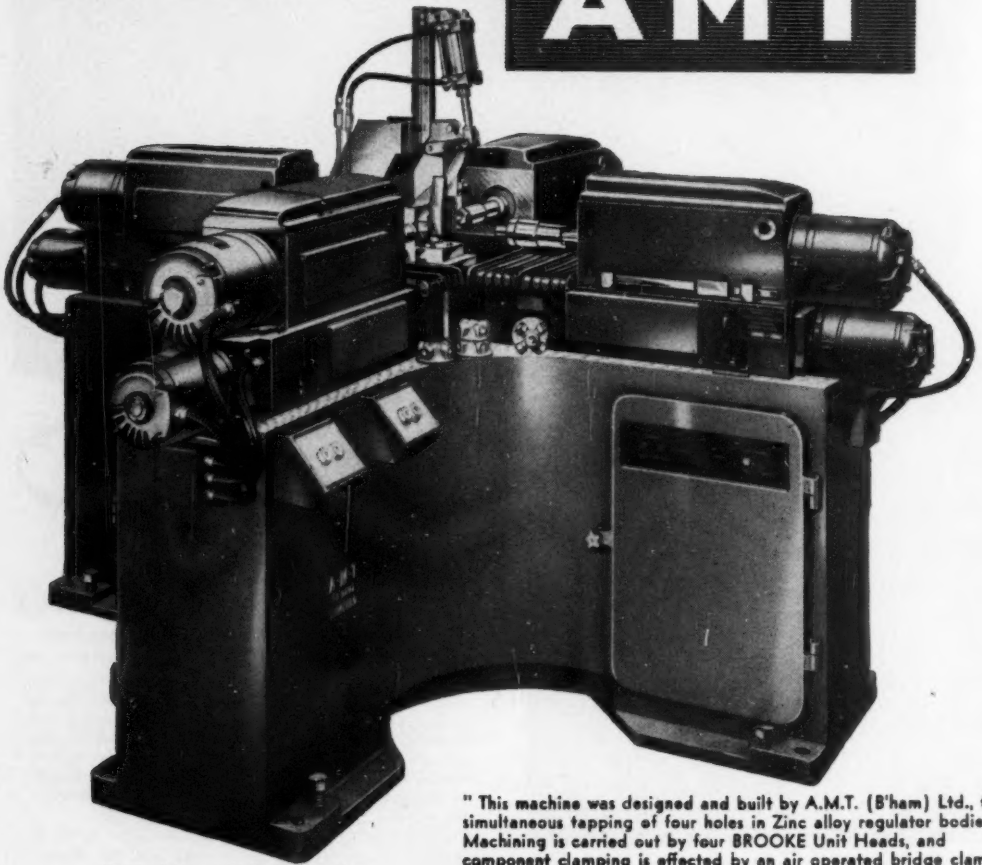

If you have a similar production problem our Design Engineers are at your service.

" This machine was designed and built by A.M.T. (B'ham) Ltd., for simultaneous tapping of four holes in Zinc alloy regulator bodies. Machining is carried out by four BROOKE Unit Heads, and component clamping is effected by an air operated bridge clamp. Electrical and air control equipment is built into the base, with setting switches and buttons mounted on the compartment doors. A 6-spindle tapping Multi Head was supplied with the machine for attachment to the rear Unit Head for a subsequent operation, tapping six equally spaced holes on the component periphery. Floor to floor time per component is 11 seconds."

A.M.T. (B'HAM) LTD. BOURNBROOK, BIRMINGHAM, 29.

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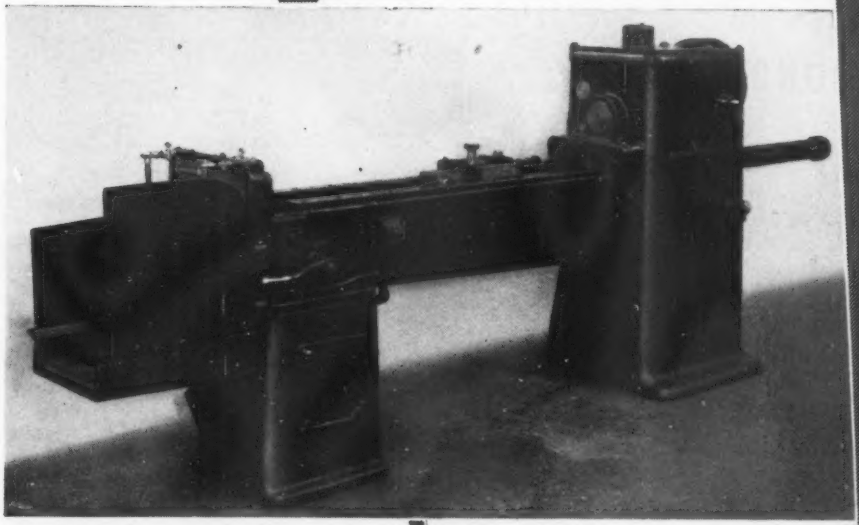
. . . versatile and adaptable to most requirements



Screw-operated machine with maximum pull of broach—20 tons

Maximum width of keyway cut, in steel, approx.—3"

Maximum width across flats of square hole broached from round hole, in steel, approx.—3"

Approximate capacity only can be given as much depends on Type of Broach, Length of Work, Stock Removal, Material, Etc.

- SPLINES
- SERRATIONS
- ROUND, SQUARE OR HEXAGON HOLES
- SPECIAL FORMS
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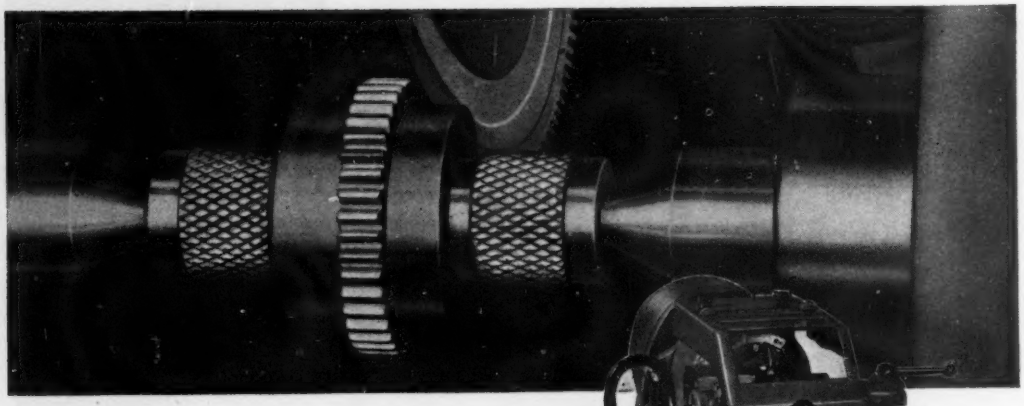

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The Sykes VS4A is a machine designed first and foremost for the fast shaving of fine pitch gears to a *consistently* high degree of accuracy; especially for the precision finishing of fine pitch gears for electronic instruments, control mechanisms and similar precision apparatus.

The VS4A can shave spur and helical gears up to 4 inches in diameter and 1 inch face width, with a pitch as coarse as 16 D.P.

As with all Sykes machinery, the VS4A is built to the highest standards of accuracy and rigidity. It occupies the minimum of floor space, and its simple loading enables it to be operated quite easily by unskilled labour. If required, automatic loading can also be employed.

The VS4A, once loaded, will rapidly and automatically perform a full cycle of operation varying from 13 to 45 seconds—depending on the material and characteristics of the component.

If you want perfection . . .

highest accuracy, best surface finish and quietest operation is achieved by gears which have been shaved. If the fine pitch gears you produce have a total composite error of more than 0.0003 inches, you should find out more about the VS4A.

SYKES

PRECISION GEAR SHAVERS

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and associated companies
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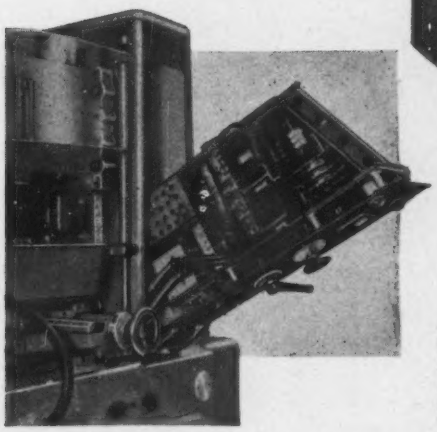
THE *FIRST* SPARK ERODER BUILT AS A PRECISION MACHINE TOOL

ELERODA D1

Today's answer to the making of Drawing and Piercing Dies and the making and reconditioning of Forging and Stamping Dies—Machines the "Unworkable" metals.



A precision Swiss built machine which is today's answer to the machining by electro erosion of metals of any hardness such as hardened steel, tungsten carbide and nimonic without causing distortion of work or alteration of mechanical or physical properties of machined surfaces. The patented electrical circuit combined with the sensitive electro hydraulic servo-mechanism ensures speed of operation and high precision. Six different surface finishes from coarse for roughing to the finest finish are obtainable. 20 power settings. Automatic depth cutout.

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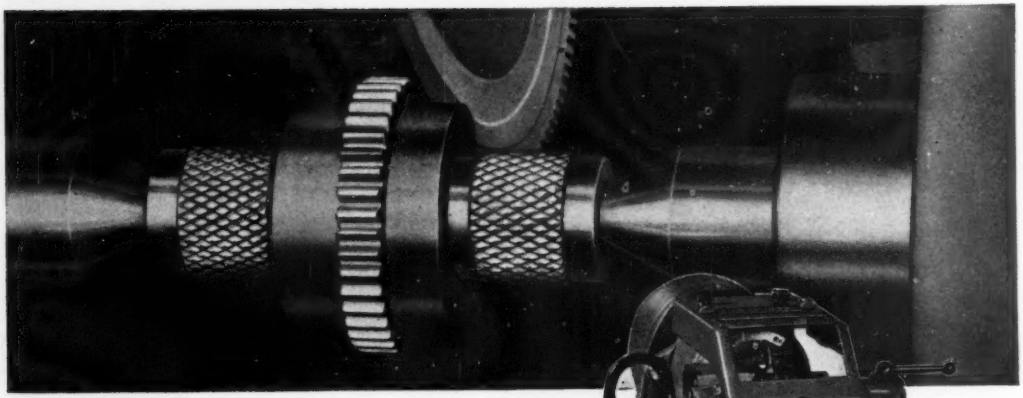

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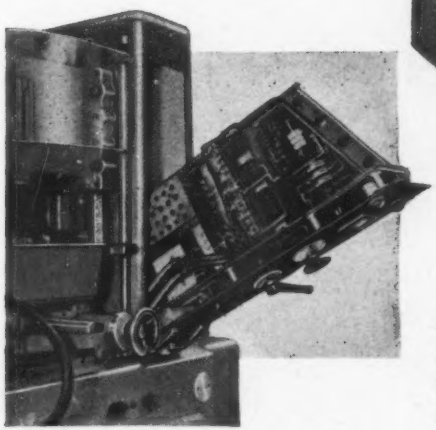
Today's answer to the making of Drawing and Piercing Dies and the making and reconditioning of Forging and Stamping Dies—Machines the "Unworkable" metals.



A precision Swiss built machine which is today's answer to the machining by electro erosion of metals of any hardness such as hardened steel, tungsten carbide and nimonic without causing distortion of work or alteration of mechanical or physical properties of machined surfaces. The patented electrical circuit combined with the sensitive electro hydraulic servo-mechanism ensures speed of operation and high precision. Six different surface finishes from coarse for roughing to the finest finish are obtainable. 20 power settings. Automatic depth cutout.

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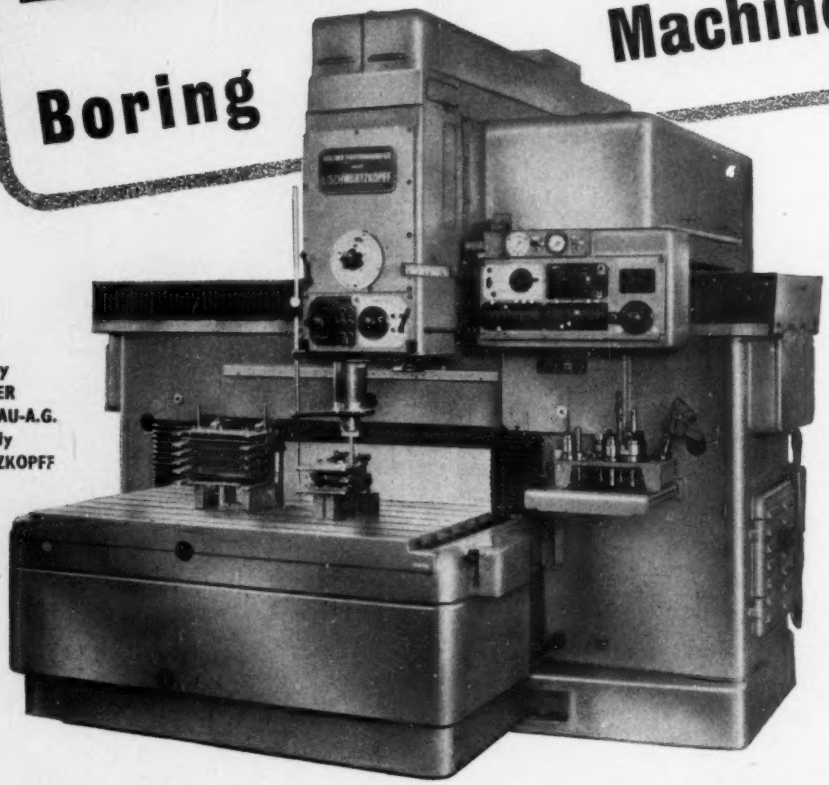
Punched card control

Boring Machines



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There are more BEMAG punched card controlled, automatic positioning Boring Machines in use in this country than any other make. The BEMAG Production Boring and Milling Machine for JIGLESS Production represents a revolutionary approach to single, batch and mass production Boring and incorporates automatic pre-selection of co-ordinate settings as well as feeds and speeds.

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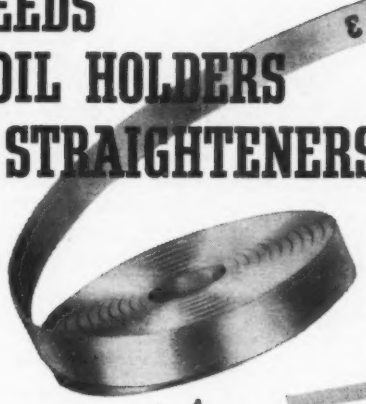

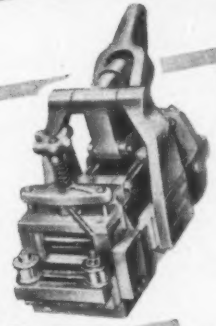

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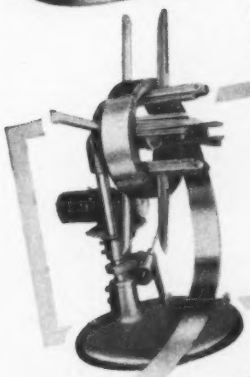
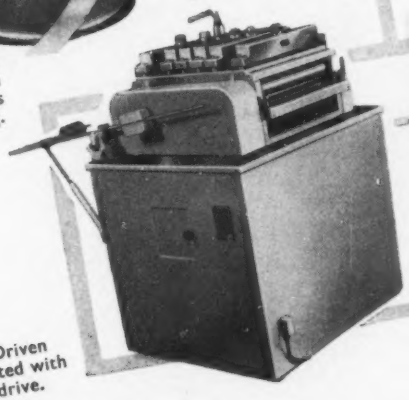
ACC—1-9 Multi-Roll Economy Cradle power driven take-out and coil rest rollers.



AR2 Automatic Stock Reel with collapsible arms for easy loading.

ACC1-2048 Inclined Coil Cradle with motorised elevating mechanism and automatic unwinding.



PDS-12 Power Driven Straightener fitted with variable speed drive.

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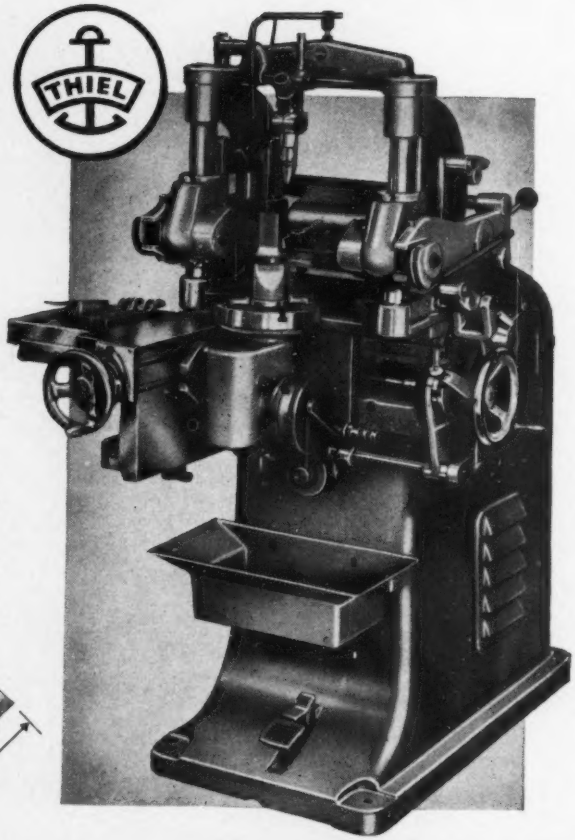
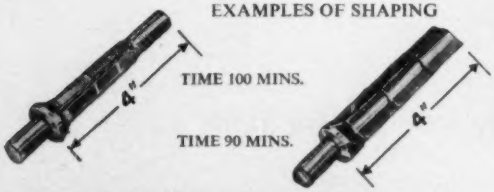
THIEL 132

PUNCH SHAPING MACHINE



Easily produces stepped electrodes, thus enabling one electrode to be used for both roughing and finishing.
Machining of intricate shapes made easy.
Punch and electrode can be made together from one piece of steel, or if copper electrode required, in one operation by previously soldering the copper part on to the steel part.
Machine is capable of taking heavy cuts up to 1/8" on steel, yet fine finishing cuts of .0005".
Can be used for punches with or without base radii.

EXAMPLES OF SHAPING



ROCKWELL MACHINE TOOL CO. LTD.

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THE COMPLETE TOOLROOM MACHINE

- JIG BORING
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- * VERTICAL MILLING
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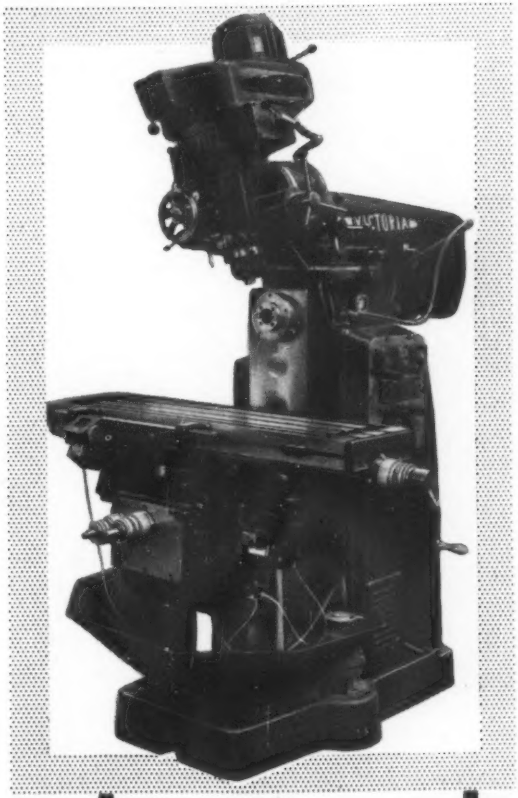

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*and standard attachments * as used with your Victoria U1 and U2 Universal millers.*

01—40" x 11" table, power longitudinal table feed, 3 h.p. spindle motor.

02—45" x 11" table, power feed to all table movements, 4 h.p. spindle motor.

OPTICAL MEASURING EQUIPMENT as illustrated or dial gauges and measuring rod troughs available as extra equipment.

VICTORIA OMNIMIL

12 horizontal spindle speeds 31-1010 r.p.m. : 18 table feeds 0.4-12.25 in./min. : 8 vertical spindle speeds 80-2700 r.p.m : 3 power feeds .0015", .003" and .006" with auto trip : coarse and micrometer hand feed.

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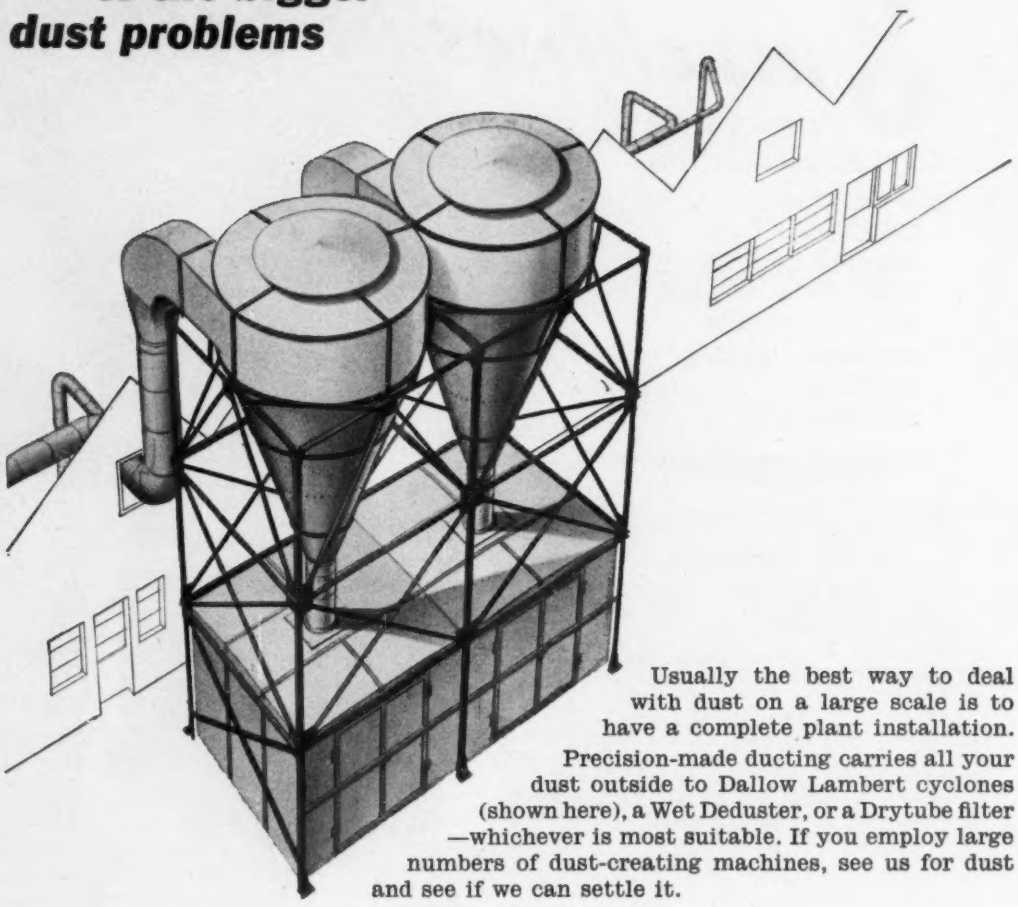
NRP 1826

This is an answer to the bigger dust problems



Usually the best way to deal with dust on a large scale is to have a complete plant installation.

Precision-made ducting carries all your dust outside to Dallow Lambert cyclones (shown here), a Wet Deduster, or a Drytube filter —whichever is most suitable. If you employ large numbers of dust-creating machines, see us for dust and see if we can settle it.

see us for dust

DALLOW LAMBERT

DUST CONTROL EQUIPMENT FOR INDUSTRY

There's a resident Dallow Lambert man in your area

DALLOW LAMBERT & COMPANY LIMITED, THURMASTON, LEICESTER

CRC 72

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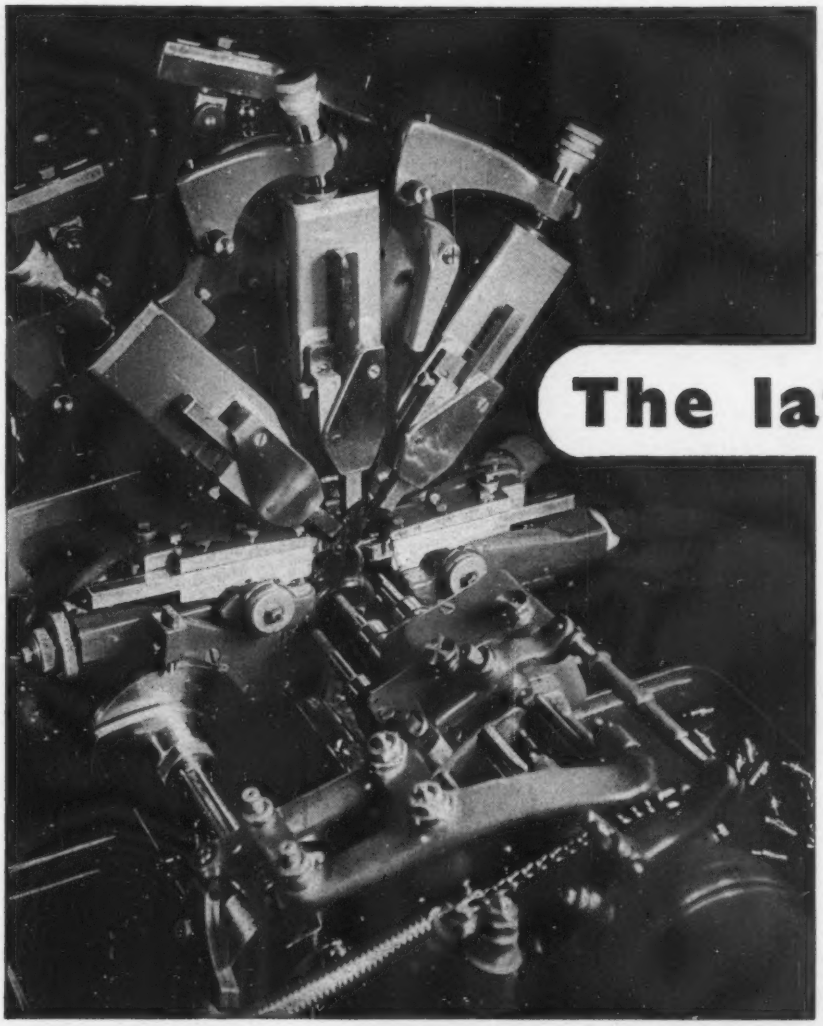

The latest

TORNOS

SLIDING HEAD AUTOMATIC

MODEL R.16

● This model R 16, built by the world's largest and oldest producers of Swiss-type automatics, is the last word in performance, precision and production capacity.

Stock capacity ⅛in. dia., with a maximum turning length of 3½in. or 6in., according to type of cam. 28 spindle speeds 485 to 5,450 r.p.m.

TORNOS Automatics are available in the following sizes:-

Model	M4	M7	R10	R16	M25/28
Max Dia. Bar	5/32	9/32	15/32	5/8	1 3/32

Telephone Coventry 40606 for full details

TORNOS SALES COMPANY, (E. M. Vaughan Ltd.) BROADGATE HOUSE, COVENTRY

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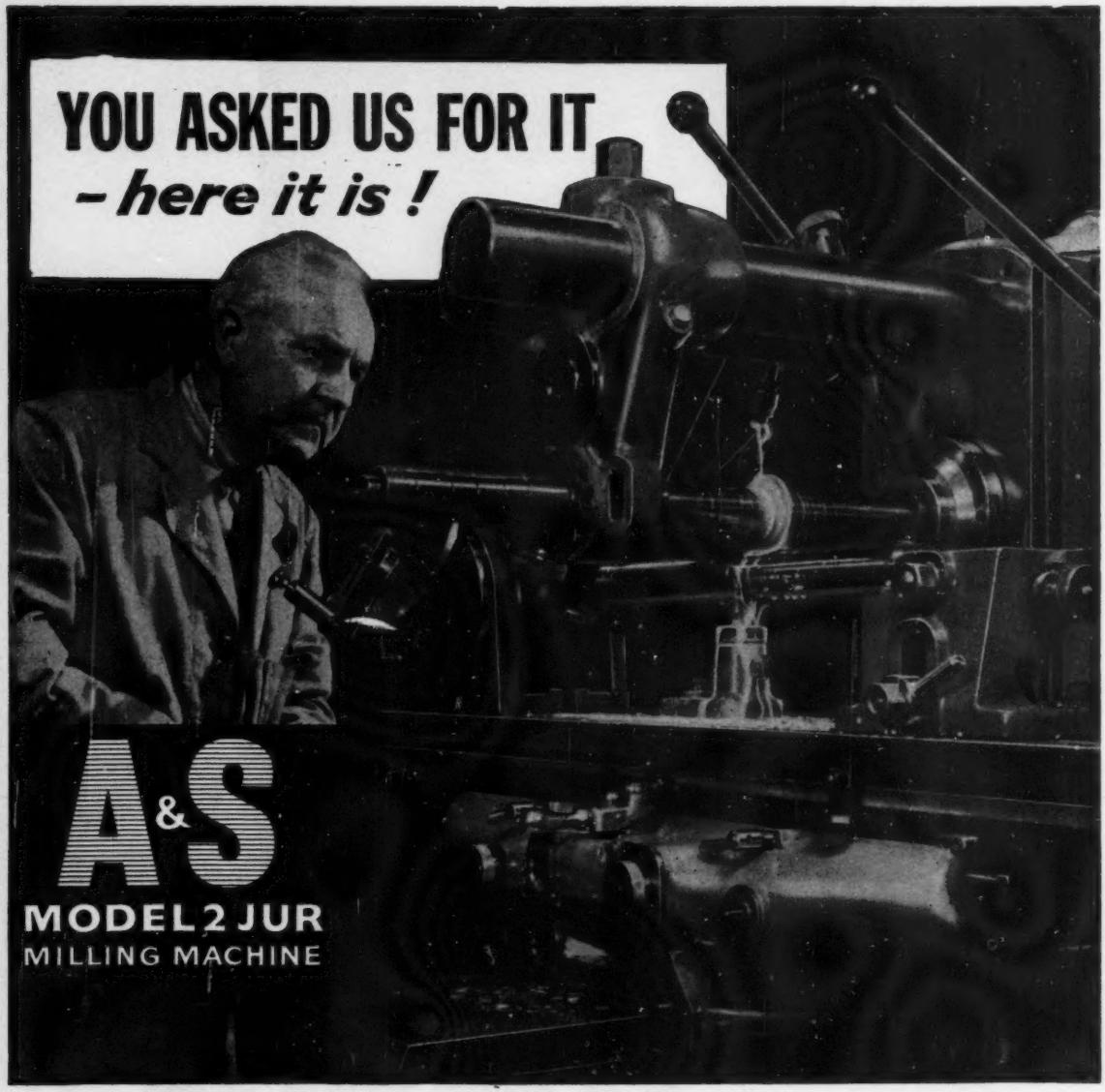

A very high quality machine possessing every desirable feature which it is possible to build into a milling machine intended for toolroom or batch production use.

- *Table size 50" x 10"*
- *Rapid traverse ALL WAYS*
- *Positive backlash eliminator, with hardened table screw*
- *Push button oiling*
- *24 speed changes, from 30 to 1200 r.p.m.*
- *15 feed changes, from ½" to 30" per minute*
- *"Easy-set" large diameter micrometer dials*
- *Knee of massive section of 11½" wide bearing surface to cross slide*
- *"Finger-light" positive knee lock*

Built up to a standard, not down to a price

ADCOCK & SHIPLEY LTD P.O. BOX 22, ASH STREET, LEICESTER
Tel. Leicester 24154-8 : Telegrams and Cables : Adcock Leicester

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MARBAIX

FOR UNUSUAL MACHINES

MINUTES SLASHED TO SECONDS . . .

on the new

MARBAIX
M58 DISINTEGRATOR

● **REMOVES BROKEN TOOLS WITHOUT DAMAGE TO THE COMPONENT**

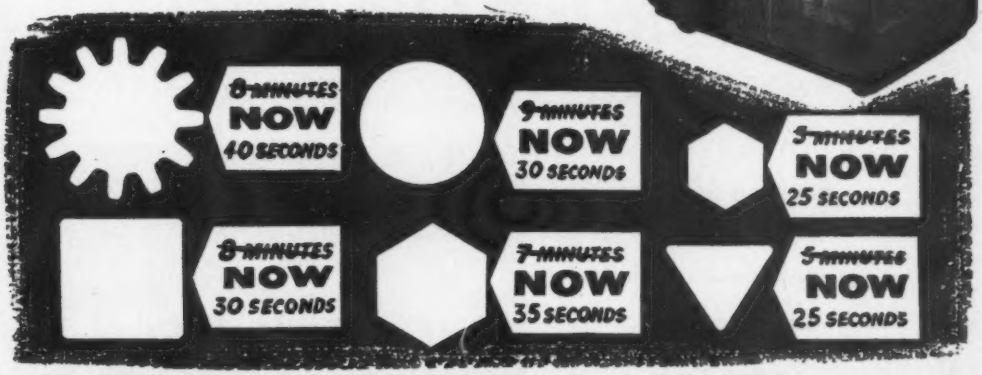
● **CUTS HOLES OF ANY SHAPE IN HARDENED MATERIAL, CARBIDES ETC.**

. . . in fact any material through which electric current can pass.

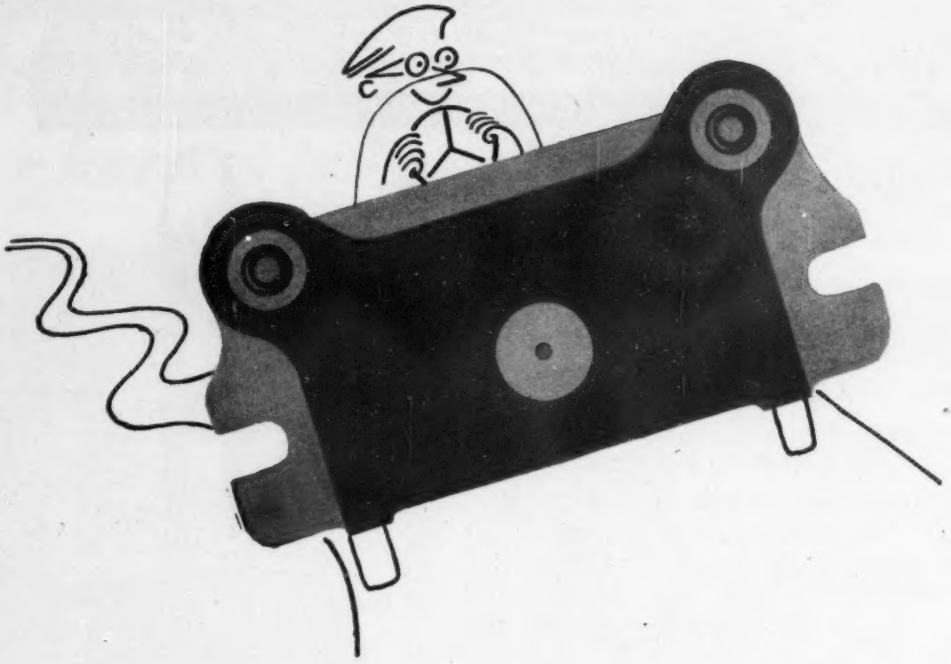
The new MARBAIX M.58 disintegrator removes broken taps, drills, reamers, studs, etc., in a fraction of normal time, without damage to the component.

Holes, too, of any shape can be cut in hardened material for subsequent finishing by grinding or other methods. Note the times for the various examples shown, and write today for full details to Dept. M.I.

*** HERE'S HOW TO CUT COSTS**
Times obtained on Model M58-C (as illustrated)


8 MINUTES NOW 40 SECONDS
9 MINUTES NOW 30 SECONDS
5 MINUTES NOW 25 SECONDS
8 MINUTES NOW 30 SECONDS
7 MINUTES NOW 35 SECONDS
5 MINUTES NOW 25 SECONDS

MARBAIX INDUSTRIES LTD
VALIANT HOUSE, VICARAGE CRESCENT
BATTERSEA, LONDON S.W.11
PHONE: BATTERSEA 8888 (8 lines)



Faster deliveries of Desoutter Die Sets!

All orders are ready for despatch within 24 hours and delivered immediately in the greater London area by our own transport. Deliveries to other areas — up to 4 days.

Better die sets—and at better prices.

Telephone your order to—London: Colindale 6346. Birmingham: Central 1508.

Head Office: 121 Hay Lane, Kingsbury, London, N.W.9. *Telephone:* Colindale 6346. *Telegrams:* Despnuco, Hyde, London.

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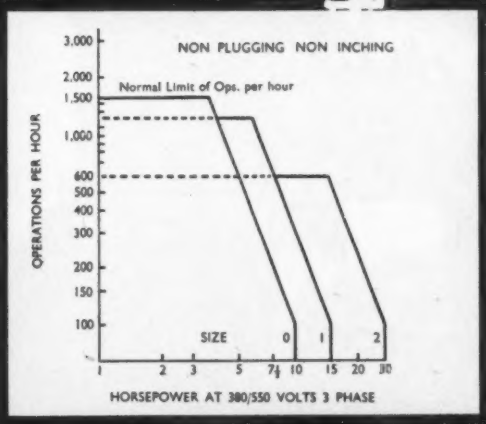
Scaled to your requirements

Make it . . .

. . . smaller, more compact and longer lasting, said the buyer

. . . easier to install and maintain, insisted the electrician

and I must have long-term reliability, demanded the works manager



IGRANIC

IGRANIC ELECTRIC CO LTD

HEAD OFFICE AND WORKS BEDFORD ENGLAND

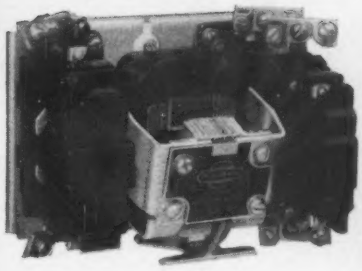
LONDON & EXPORT OFFICES VICTORIA STN. HOUSE

191 VICTORIA ST LONDON SW1

A METAL INDUSTRIES GROUP COMPANY

DISTRICT OFFICES

M1



" We've met your requirements," said the Igranic engineers. " They are all incorporated in the new Igranic Block-type Contactor "

- It occupies less space than hitherto.
- It's engineered to withstand constant and rapid operation for long periods.
- Key-hole slot mounting and accessible terminals with positive, pressure clamped connections simplify installation.
- Pull-off, snap-on covers give instant access to contacts—moving contact assemblies lift out without disturbing wiring—armature lifts off —no tools required.
- Twin-break, heavy-duty, sintered silver contacts are vertically mounted and so 'dust-safe'. They never need filing or cleaning.
- Ample arc rupturing capacity is effected by special design of totally enclosed arc chambers.
- Auxiliary contacts are added easily.

A.C. RATING UP TO 30 H.P. NOW, UP TO 100 H.P. SHORTLY.

Can be provided with D.C. operating magnet.

MADE IN A COMPLETE RANGE OF SIZES

BIRMINGHAM BRISTOL CARDIFF EAST ANGLIA LEEDS GLASGOW MANCHESTER NEWCASTLE SHEFFIELD

F2345

If you face mill light alloys . . .

here's how to put your finger on 60% more production!

The latest Wadkin Articulated Arm Router has considerably increased output rates and drastically reduced production costs in scores of shops. The reason is this: Wadkin machines are not orthodox millers but machines specially designed for high-speed working in Non-ferrous Metals. With cutting speeds up to 18,000 r.p.m. and low tooth loading of the cutter, face-milling operations are accurately machined in a fraction of the time taken by any other method, and only light clamping of the component is necessary. No further finishing operation is required. May we prove the amazing output capabilities of this machine—preferably by a demonstration on your own job.

A Wadkin Articulated Arm Router, type L.C. face-milling a filter plate at Brytallium Castings (Bolton) Ltd., Bolton. A finished component is shown in the foreground.

Wadkin

Wadkin Ltd., Green Lane Works, Leicester. Tel.: 68151. London Office: 62 Brook St., W.1. Tel.: MAYfair 7048

HEAVY DUTY

CLAMPTIP

PLANING TOOLS

on the Veraloy principle perform
better and cost less to buy and to regrind.
Write for particulars to:

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INE CORING means INE CASTING

We are particularly proud of this casting, a steel plug used in the paper making industry. It involved very intricate ribbing to close dimensional tolerance—without machining.
On jobs of this kind our special coring technique enables us to guarantee not only a good surface finish, but also the closest possible limits.

Whatever your needs in steel castings, carbon, alloy or stainless—from a few pounds to 30 cwt. you can rely on BAKERSTEEL.

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CARBON & ALLOY STEEL CASTINGS

W. A. BAKER & CO. LTD., WESTGATE WORKS, NEWPORT, MON., 'PHONE: NEWPORT 64845

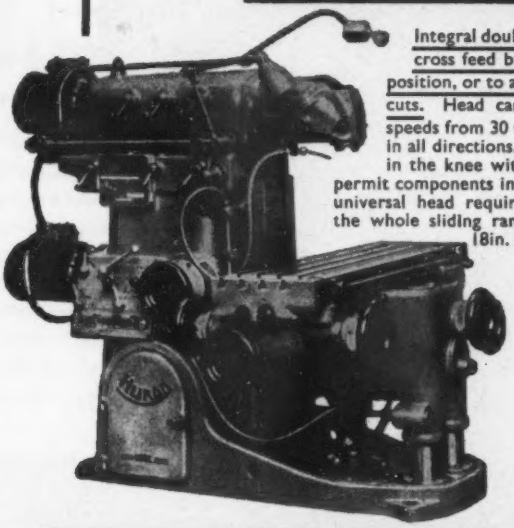
DIVISION OF BLACK-CLAWSON INTERNATIONAL, LTD.—MAKERS OF PAPER MILL PLANT

HEAVY DUTY MILLING

ANGULAR COMPOUND HORIZONTAL VERTICAL

HURON SUPER UNIVERSAL MILLERS

SLIDING RAM GIVES 27½in. AUTO CROSS FEED



Integral double swivelling universal head provided with 27½in. automatic cross feed by the sliding ram, can be set to the horizontal or vertical position, or to any angle instantaneously—permits the heaviest production cuts. Head can be retracted completely from table line. 27 spindle speeds from 30 to 2,066 r.p.m. 27 feeds from $\frac{1}{2}$in. to 30in. Rapid traverses in all directions. All operating controls duplicated. Table slides directly in the knee without cross movement or swivel. Double guides of knee permit components in excess of 1½ tons to be machined. The double swivelling universal head requires an opening of only 14in. to enter work pieces and the whole sliding ram with its 27½in. automatic cross movement needs only 18in. clearance.

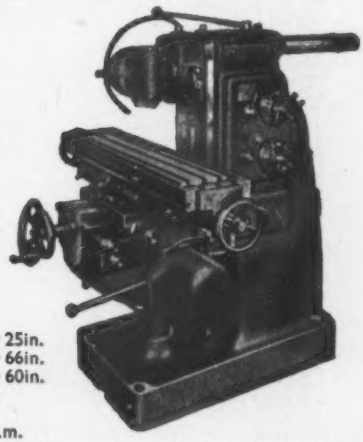
Type	Table	Automatic Feeds Long	Cross	Vert.
KU4	56$\frac{3}{16}$in. × 15¾in.	43¼in.	27½in.	19¾in.
KU5	64$\frac{3}{16}$in. × 15¾in.	51¼in.	27½in.	19¾in.
KU6	78¾in. × 16¼in.	59in.	27½in.	19¾in.
L7	157in. × 39in.	118in.	27½in.	39¾in.

Type 'L' Open-side Traversing Head Universal Miller will mill, bore, slot and drill the largest work-pieces at one setting.
The unique design permits greatest variety of operation on large work-pieces; the component remains stationary on the large work-table. Upright slides full length of base table, and the sliding ram moves vertically and horizontally.

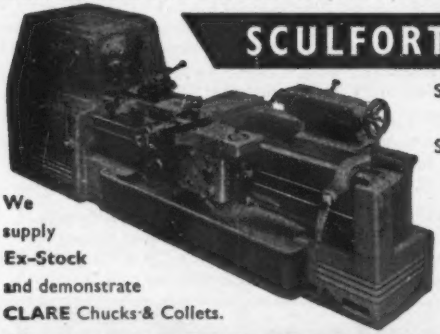
DUFOUR UNIVERSAL MILLERS

Table surface 43$\frac{3}{16}$in. by 9¾in. or 47¼in. by 10⅞in. Auto long. feed, 26¾in. or 30¾in. Auto vert. feed, 15¾in. or 18⅞in. Auto cross feed 9¼. Rapid traverse in all directions. No. 40 International taper for main spindle, universal head, and rotary table. Direct reading dial change for speeds and feeds. All parts subject to wear hardened and ground and completely interchangeable. Built to closest tolerances. Spindle speeds 21 to 1,600 r.p.m. Twin overarms. Separate motor for rapid traverses.

Also table 63in. by 15in., with auto feeds: 40in. long., 21in. vert., 14in. cross; 25in. auto-univ. head feed. 36 spindle speeds 6 to 1,500 r.p.m.



SCULFORT LATHES



We supply Ex-Stock and demonstrate CLARE Chucks & Collets.

Swing over bed 20, 22 or 25in. and 28, 32 or 66in. and 40, 47 or 60in.
Speed ranges: 6-2,000; 12-1,600; or 3½-325 r.p.m.

18-45 h.p. motor drives for max. output. Totally enlcosed gear box provides 90 different pitches. Flame hardened bed. Large spindle bore. All head stock gears hardened and ground. Built-in coarse screw cutting device.

Other products: Copying lathes, Locomotive and Carriage Wheel Turning Lathes, Centreless Bar Turning Machines, Facing Lathes and Special Purpose Centre Lathes.

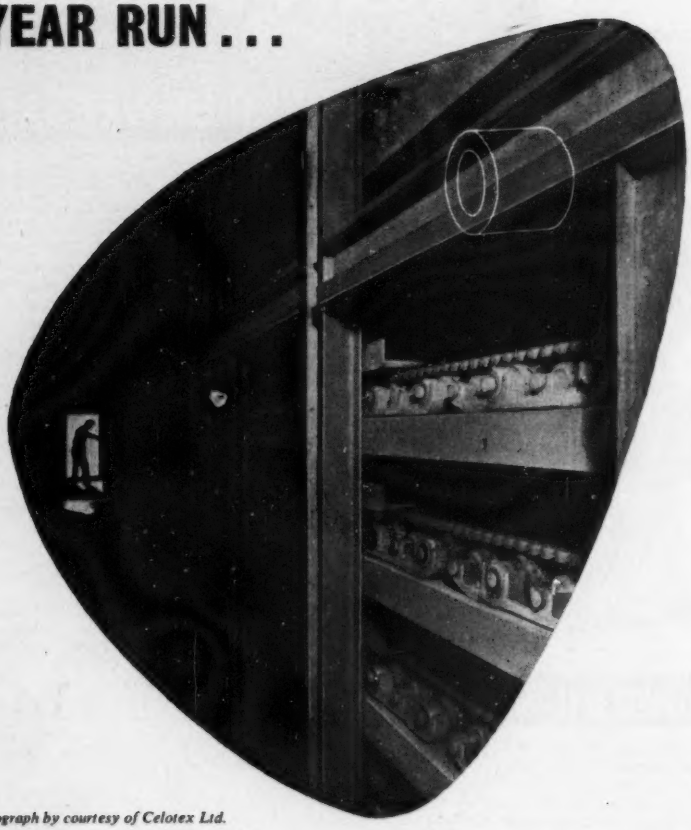
Rudolph Carne & Co. Ltd. SWAN WORKS, FISHERS LANE, CHISWICK, LONDON, W.4.

Telephone: CHISWICK 0514 & 6585. Inland Telegrams: RUDCAR, CHISK, LONDON. Overseas Telegrams: RUDCAR, LONDON.

MÉCANÉLEC EXHIBITION, PARIS, 12th to 21st SEPTEMBER, 1958

THE LATEST TYPES OF THESE OUTSTANDING MACHINE TOOLS WILL BE SHOWN ON STANDS NUMBERS 1R35, 1R72, AND 1R85 WHERE OUR ENGINEERS WILL BE IN ATTENDANCE.

A FOUR YEAR RUN . . .



Photograph by courtesy of Celotex Ltd.

This drying conveyor illustrates one of the many applications of MORGANITE CARBON BEARINGS where carbon is the most suitable material. Thousands of tons of Wallboard pass over these rollers every year—4,000 MORGANITE CARBON BEARINGS undergo severe duty to make this possible—each carries a load of about 30 pounds and is subjected to temperatures up to 650°F in a very dry and dusty atmosphere. In spite of these arduous conditions replacement is only necessary after 4 years.

MORGANITE CARBON BEARINGS solved the problem for CELOTEX—perhaps they will solve your's today. Please write or 'phone for leaflet SD.63, or ask for one of our Technical Advisers to call.

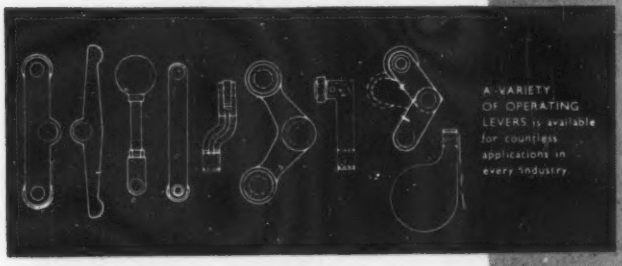
MORGANITE CARBON BEARINGS withstand high temperatures; will run in liquids; resist chemical atmospheres and corrosive conditions; need no lubrication; are useful for inaccessible positions; are non-contaminating and eliminate maintenance.

MORGANITE **BEARINGS**

THE MORGAN CRUCIBLE COMPANY LIMITED, BATTERSEA CHURCH ROAD, LONDON, S.W.11.
Telephone: BATtersea 8822
C64a

limit switch

For all heavy duty limit switch applications, particularly those to withstand conditions of extreme severity, there is a suitable B.S.A. ACME SNAP-LOCK of either water, oil, and dust proof, or flameproof versions. The superiority of this switch is due largely to the simplicity but ruggedness of its mechanical and electrical units contained in separate compartments within a robust housing. Unique Snap-Lock design ensures self-wiping quick make and break, positive contact, maximum resistance to wear, and accurate repetitive tripping.



NEUTRAL POSITION

These limit switches are available in Neutral Position versions. Spring-loaded devices return the operating lever to the central (neutral) position. One or both of the springs are removable for various circuit arrangements. A third spring is supplied for converting to one normally made and one normally broken circuit.

B.S.A ACME MADE UNDER LICENCE FROM NATIONAL ACME CO. U.S.A.

snap-lock

B.S.A. TOOLS LTD. BIRMINGHAM.33.ENGLAND

Sole Agents Gt. Britain :

BURTON GRIFFITHS & CO. LTD.

Snap-Lock Division : 93 Albert Embankment, London, S.E.11

Phone : RELIANCE 3891

Ad. No. 431

STANDARD

Single pole, double break, double throw, operates with either circuit normally open with other closed, or maintaining in either position, or available with central neutral position. Heavy die-cast case. Water, oil and dust proof. Conduit ¾" in. B.S., or No. 3 Admiralty Pattern Cable gland entry. Two-screw side mounting or backplate mounting in two styles, or Tandem style (back to back mounting). Operating lever position adjustable in 7.5 deg. increments through 82.5 deg. either way from normal.

FLAMEPROOF

Buxton certificates *No. 3574 (Group I) No. 3575 (Groups II and III gases). Meehanite iron castings. Self wiping solid silver contacts, interchangeable plugs and sockets. Internal mechanism removable as a unit for servicing.* **Single SWA cable entry (standard); double entry if required.** *Operating lever position adjustable in 7.5 deg. increments through 360 deg. Single pole, double break, having one normally closed and one normally open circuit. Available with central neutral position.*

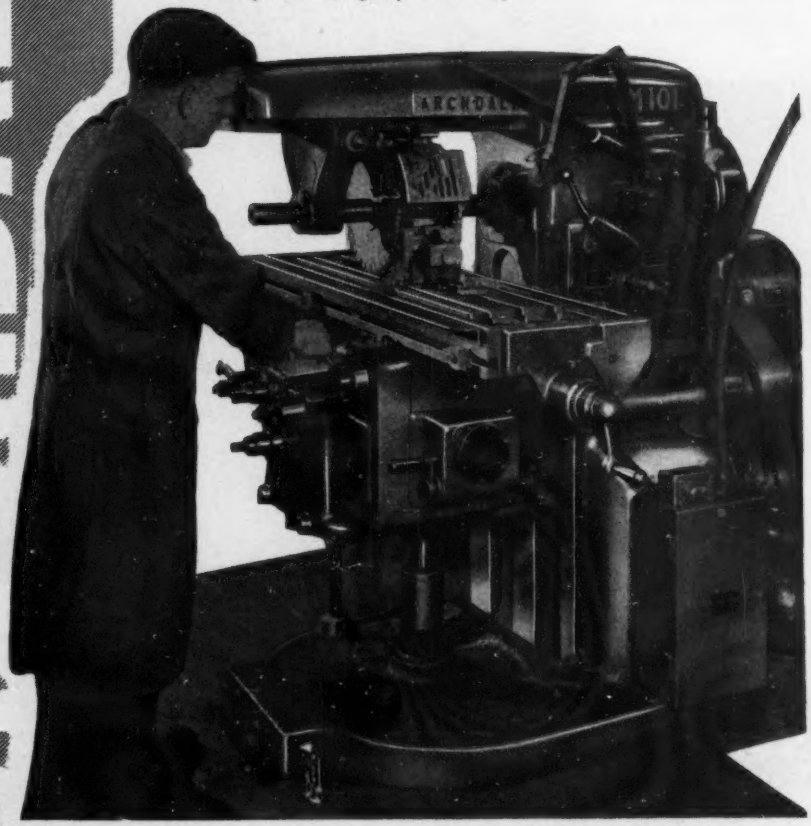
ARCHDALE 28"

COMBINES ACCURACY WITH THE POWER AND SPEED TO REDUCE COSTS

- **ANTI-BACKLASH DEVICE**
- **BUILT-IN CLIMB MILLING**
- **REVERSIBLE LONGITUDINAL FEEDS**
- **QUICK POWER TRAVERSE**

These sturdy and powerful machines, with their many outstanding features, mean increased milling efficiency wherever they are installed. Forgrove Machinery Co. Ltd., Leeds, are no exception, and in this modern factory ARCHDALE machines are setting the pace on a variety of work, such as the straddle milling of cast iron twist boxes as shown. Six speeds, 30/462 r.p.m. with eight feeds from 0·7in. to 15·5in. per minute.

Complete details gladly sent on request.



JAMES ARCHDALE & CO., LTD., LEDSAM STREET, BIRMINGHAM, 16

A Member of the Stavely Coal & Iron Co. Ltd. Group. Telephone: EDGbaston 2276

Sole Agents: **ALFRED HERBERT LTD., COVENTRY.** Telephone: 89221

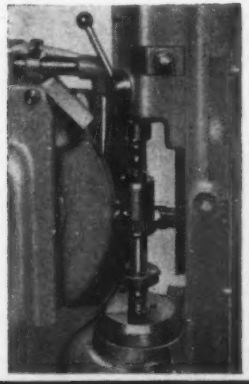
GEAR GRINDING

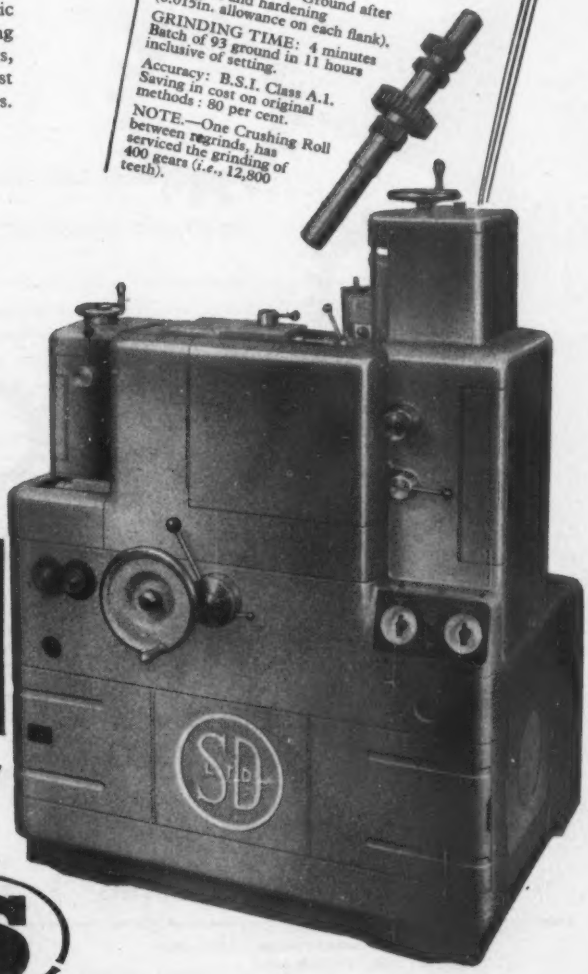
with remarkable SPEED and ACCURACY!

"Heligrind" fine pitch spur gear grinder, grinds from solid blanks or rough cut gears to B.S.I. Class A ground gear limits, in a fraction of time previously required. Automatic dressing of wheel—fast continuous grinding action—any form such as serrations, ratchets, etc., ground. Proved in practice the most accurate method of producing fine pitch gears. Maximum dia. 4½ in. D.P. 14 to D.P. 120.

CAMSHAFT GEARS

(Enfield Industrial Engines.)
16 D.P., 20° P.A., 32 teeth.
Width of TEETH: ¼in.
Material: EN 33 C/MDNP.
TEETH FINISH: Ground after rough cut and hardening (0.015in. allowance on each flank).
GRINDING TIME: 4 minutes
Batch of 93 ground in 11 hours inclusive of setting.
Accuracy: B.S.I. Class A.1.
Saving in cost on original methods: 80 per cent.
NOTE.—One Crushing Roll between regrinds, has serviced the grinding of 400 gears (*i.e.*, 12,800 teeth).



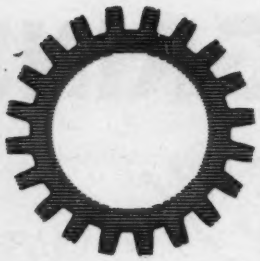


HELIGRIND
HIGH PRODUCTION
SPUR GEAR GRINDER

DESIGNED AND MANUFACTURED BY

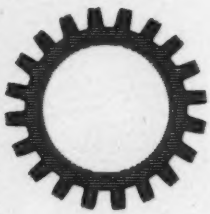
Stuart DAVIS

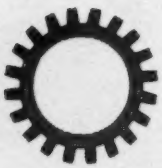
STUART DAVIS LTD. - MUCH PARK STREET - COVENTRY. ***Telephone: Coventry 63091/2***

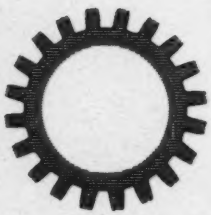


Gear Hardening is one of the several production line operations for which Induction Heating is admirably suited. The right way to tackle the problem is to ask Delapena to put their Applications Department at your disposal.

Getting your teeth into the problem





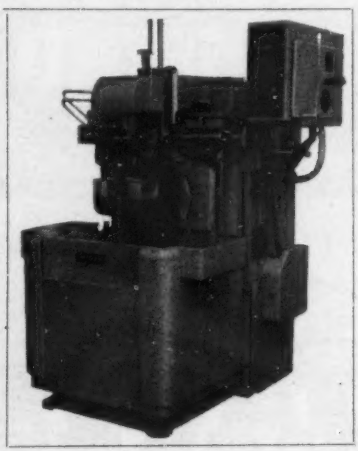


They will show, with particular reference to *your* manufacturing needs, how costs can be reduced by the elimination of grinding operations; how tooth profile can be finally hardened with the minimum of 'shape change'; and how a quieter and longer-lasting gear results.

To problems of repeat Hardening, Soldering and Brazing, Delapena Induction Heating Equipment can provide an economical answer.

Consult us now. Let us get *our* teeth into *your* problem.

This equipment, for example, is fully automatic and handles gears within a range of 1½" to 26" diameter, 2 to 10 diametral pitch, face widths up to 8" and helical gears up to 30°.



Delapena

INDUCTION HEATING

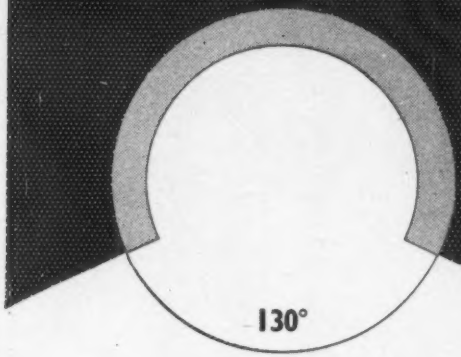
DELAPENA & SON LIMITED

Manufacturers of Induction Heating and Precision Honing Equipment

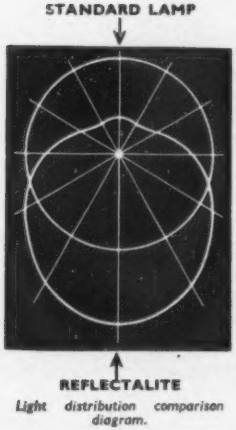
ZONA WORKS • CHELTENHAM • ENGLAND

Telephone: CHELTENHAM 56341

Get more light at no extra cost! fit PHILIPS *Reflectalite*



— the fluorescent tube that now gives even more light in the useful direction



Light distribution comparison diagram.

Philips "Reflectalite" is the fluorescent tube that defeats light wastage caused by dust accumulation. And today it's a better buy than ever. For, in addition to its basic increase in lighting efficiency, the light output of "Reflectalite" tubes has now been further increased to give you *even more light* in the useful direction. For instance, the 40W Cool White tube now has 10% greater efficiency.

"Reflectalite" has a special built-in reflector covering two-thirds of the internal surface. The major part of the light output is reflected through the 130° 'window' *where it has maximum effect.* (See diagrams.)

Available in Cool White, Cool White de Luxe, Warm White.	**SWITCH START. 4' 40W. 13/9d. plus P.T.** **5' 80W. B.C. or Bi-Pin 14/9d. plus P.T.** **INSTANT START. 1/- extra.**

Next time you need a tube - fit a

PHILIPS **PHILIPS** *Reflectalite*

FLUORESCENT REFLECTOR TUBE

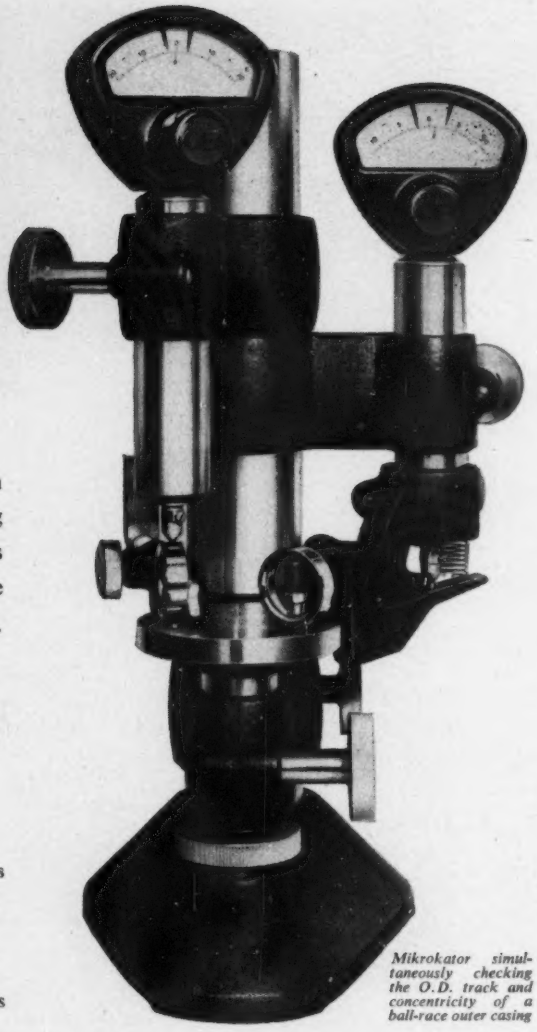
PHILIPS ELECTRICAL LTD · LIGHTING DIVISION · CENTURY HOUSE · SHAFTESBURY AVE · LONDON W.C.2

(LD3117)

CEJ

MIKROKATOR

The most sensitive mechanical comparator made.



Mikrokator simultaneously checking the O.D. track and concentricity of a ball-race outer casing

Amplifications to 5,000: 1 achieved through the unique CEJ " twisted-strip " device, giving a complete frictionless movement. This enables extremely fine measurements to be obtained to within very close limits of accuracy.

CEJ PRODUCTS

Ground Thread Taps
Chaser Dies
Screw Plug Gauges
Screw Ring Gauges
Circular Chasers and Holders
Round Dies
Thread Milling Hobs
Thread Rolling Dies
Plain Plug Gauges
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Surface Finish Indicators
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Multiple Interference Microscopes
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PRECISION TOOLS AND INSTRUMENTS

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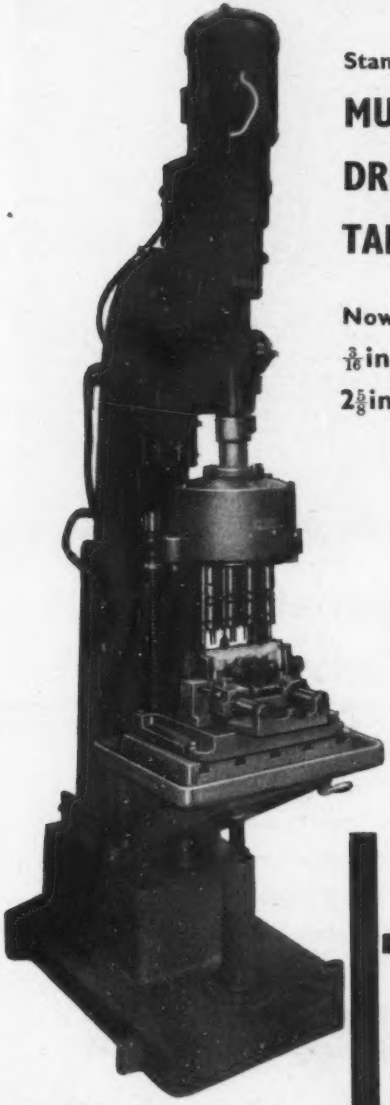
MULHEAD



Standardized

MULTI SPINDLE DRILLING AND TAPPING SETS

Now available in

$\frac{3}{16}$in. to $\frac{33}{64}$in. capacity—

$2\frac{5}{8}$in. to $10\frac{1}{2}$in. p.c.d.

Standard H.13 set, comprising ten spindle multi-drilling head, jig bush plate, and standard base casting with fitted guide pillars, mounted to type "C" Herbert Machine. Note: Special two position sliding fixture mounted to standard base casting.

Standard H.11 set, comprising ten spindle multi-tapping head and standard base casting with fitted guide pillars, mounted to No. 5 Huller controlled-pitch tapping machine. Note special two-position sliding fixture mounted to standard base casting.

THE MULHEAD ENGINEERING CO LTD

VICTORIA WORKS,

136-8 GREAT NORTH ROAD, HATFIELD, HERTS

TELEPHONE: HATFIELD 2296/7

PROFILROSS COPY MILLING MACHINE

WITH HYDRAULIC TRACER

Can also be used for normal milling work

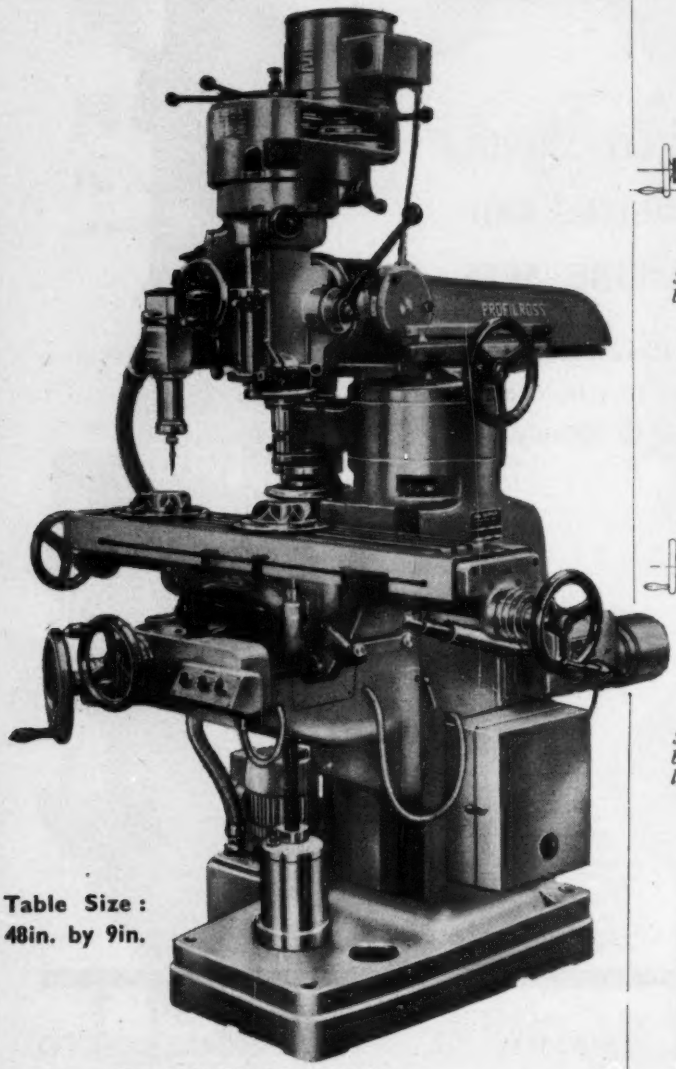
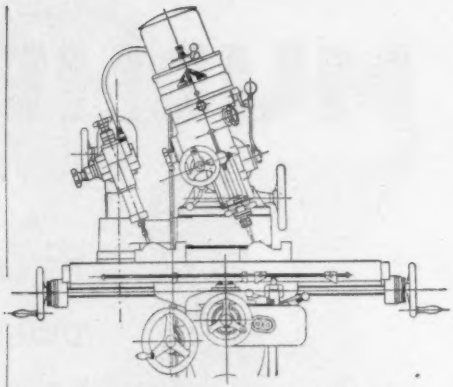
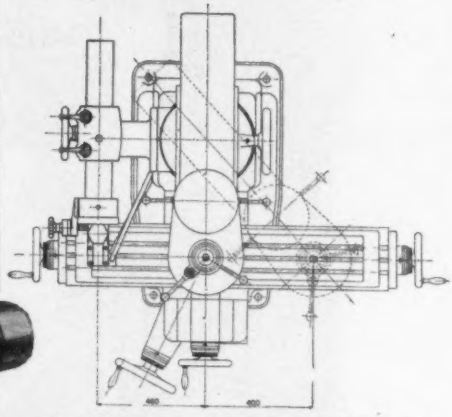


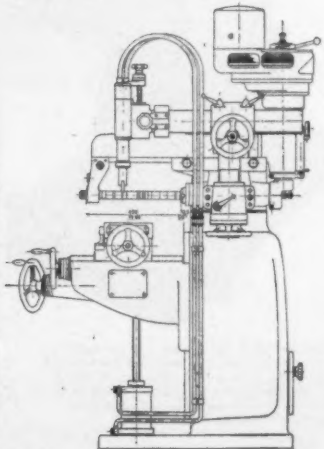
Table Size : 48in. by 9in.



Swivelling Head & Stylus allow 90° angles to be copied.



Swinging overarm allows variation in distance between milling spindle and stylus for copying large pieces.



Horizontal milling unit can be used for rise and fall copying.

See this Machine at the 1st ITALIAN MACHINE TOOL EXHIBITION, MILAN — SEPTEMBER 11th—21st.

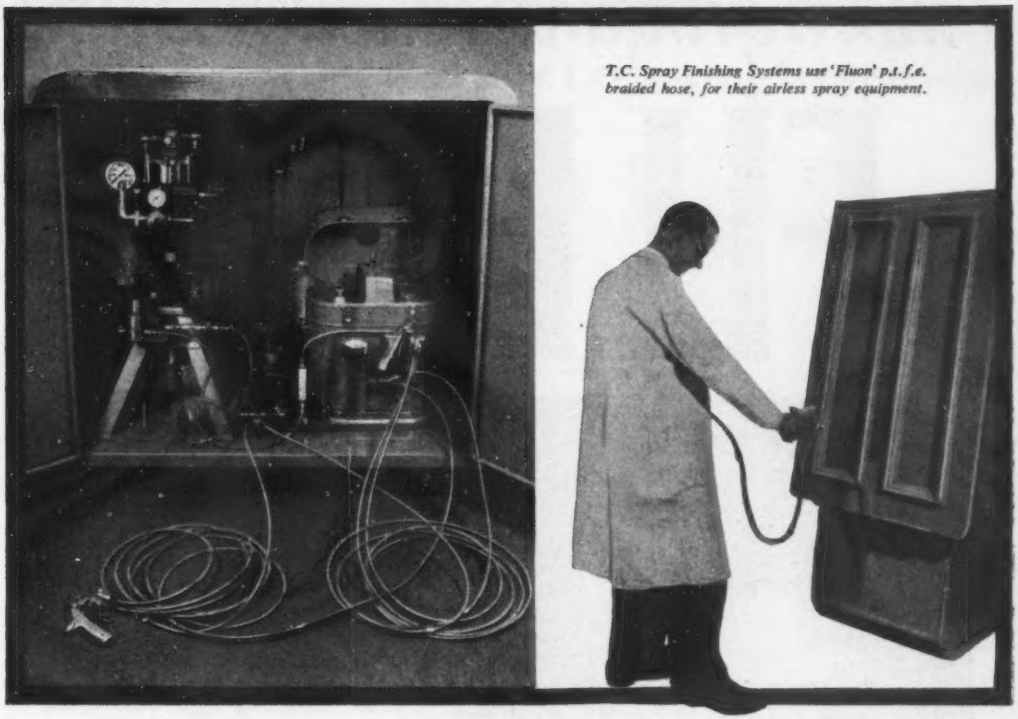
SOLE AGENTS FOR THE UNITED KINGDOM

ACBARS LTD

57a HOLBORN VIADUCT, LONDON, E.C.1

Tel: Central 6811/2, 2287/8/9

'FLUON' *increases production in the Engineering Industry*



T.C. Spray Finishing Systems use 'Fluon' p.t.f.e. braided hose, for their airless spray equipment.

Complete resistance to solvents makes 'Fluon' first choice for paint spraying hose

'FLUON' P.T.F.E. is used for the braided hose made for T.C. Spray Finishing Systems. 'Fluon' was chosen because this outstanding material is the most inert of all plastics and resists every chemical except molten alkali metals and a few fluorine compounds. 'Fluon' tubing is flexible, as the illustration shows, and is most durable. Among its range of properties are its non-wetting characteristics and the temperature range within which it works (—80°C. to 250°C.)

'FLUON'

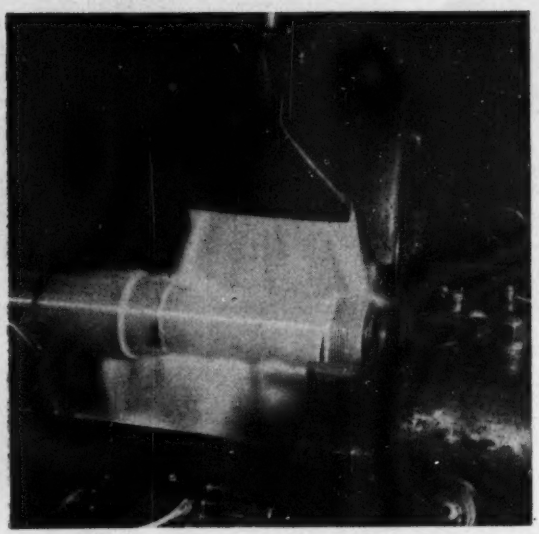
'Fluon' is the registered trade mark for the polytetrafluoroethylene manufactured by I.C.I.

IMPERIAL CHEMICAL INDUSTRIES LIMITED · LONDON · S.W.1

ICI

PF.39/1

More grinding machines use FILEDGE*



every week

There is a special niche in production engineering for the grinding fluid because grinding, in all its various forms, is so important in relation to today's production techniques.

Of the specially formulated fluids for grinding FILEDGE offers many advantages of which keener cutting and rapid sedimentation of abraded particles deserve immediate mention. The water reduction also has exceptional wetting-out properties. Your machine shop needs FILEDGE now.

By asking for Publication SP.173—on your business letterhead please—you will receive up-to-date information on FLETCHER MILLER cutting fluids.

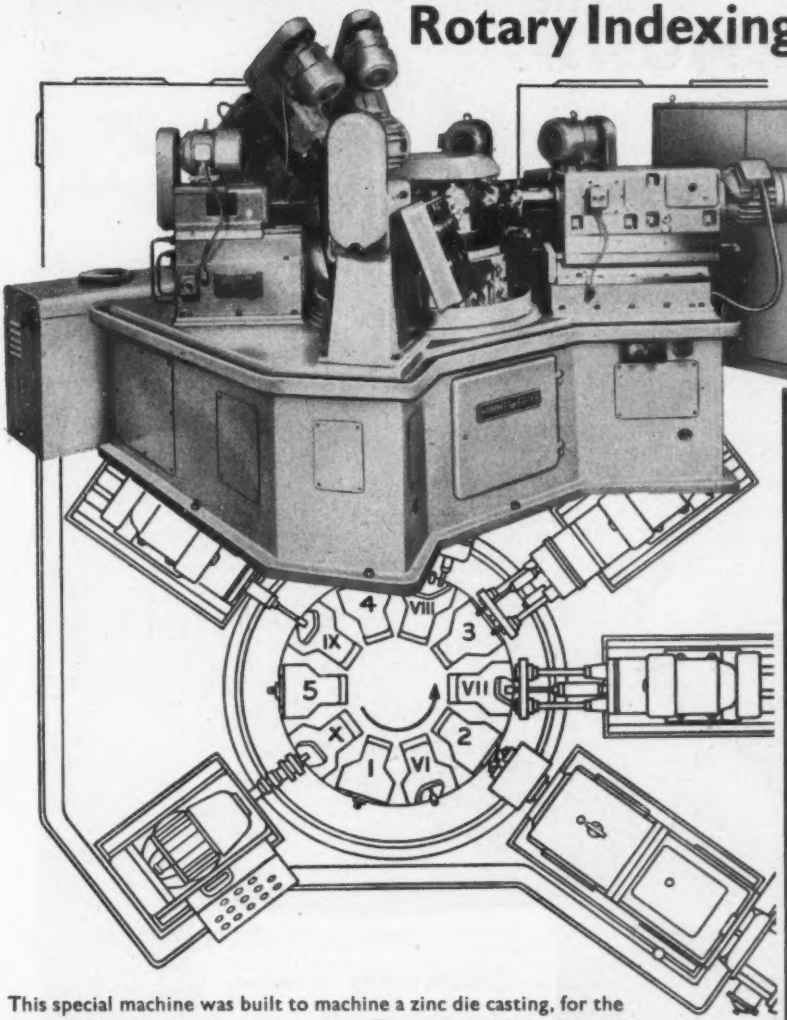
* one of the FLETCHER MILLER cutting fluids

FLETCHER MILLER LTD., ALMA MILLS, HYDE, CHESHIRE.
Telephone: HYDE 3471 (5 LINES) *Telegrams:* EMULSION, HYDE
Also at LONDON, WEST BROMWICH, NEWCASTLE-ON-TYNE, CARDIFF, GLASGOW AND BELFAST

CF 115

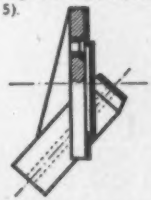
BAMMESBERGER

Rotary Indexing Machine

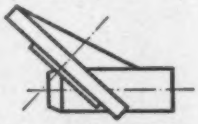


This special machine was built to machine a zinc die casting, for the windshield wiper bearing shown at right. The operator's job is limited to loading, reclamping and unloading of these parts. The machine is built up of three single-spindle drilling units, two slide units with built-on 2-spindle drilling heads, one facing unit with hydraulic shuttle table, one tapping unit and one hydraulic rotary indexing table.

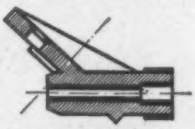
Casting loaded for machining during 1st rotation (stations 1 - 5).



Parts shown after 1st rotation (faced, drilled and spotfaced end milled).



Part premachined at stations 1 - 5 loaded for stations VI - X (2nd rotation).



Finished part after 2nd rotation (step drilled, deburred, reamed, tapped).

Output: approx. 220 pieces per hr. at 85% efficiency.

DISTRIBUTORS AND STOCKISTS FOR THE UNITED KINGDOM

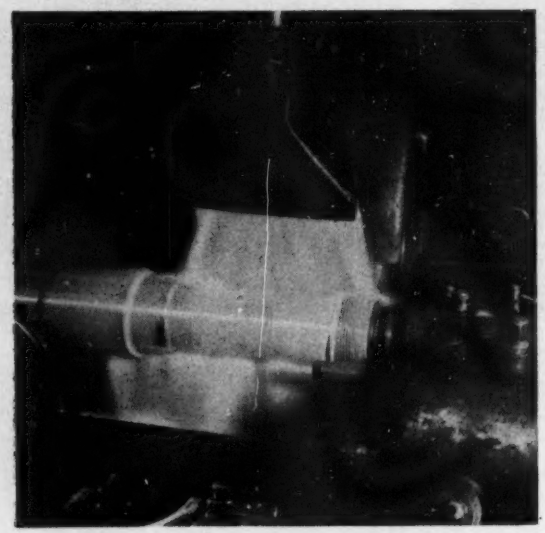
Telephone: ELGar 3834 (8 lines)

MORTIMER ENGINEERING PROPRIETORS COMPANY S. GUITERMAN & CO. Ltd

Showroom & Sales: 204/6 ACTON LANE, HARLESDEN, N.W.10

When answering advertisements kindly mention MACHINERY.

More grinding machines use FILEDGE*



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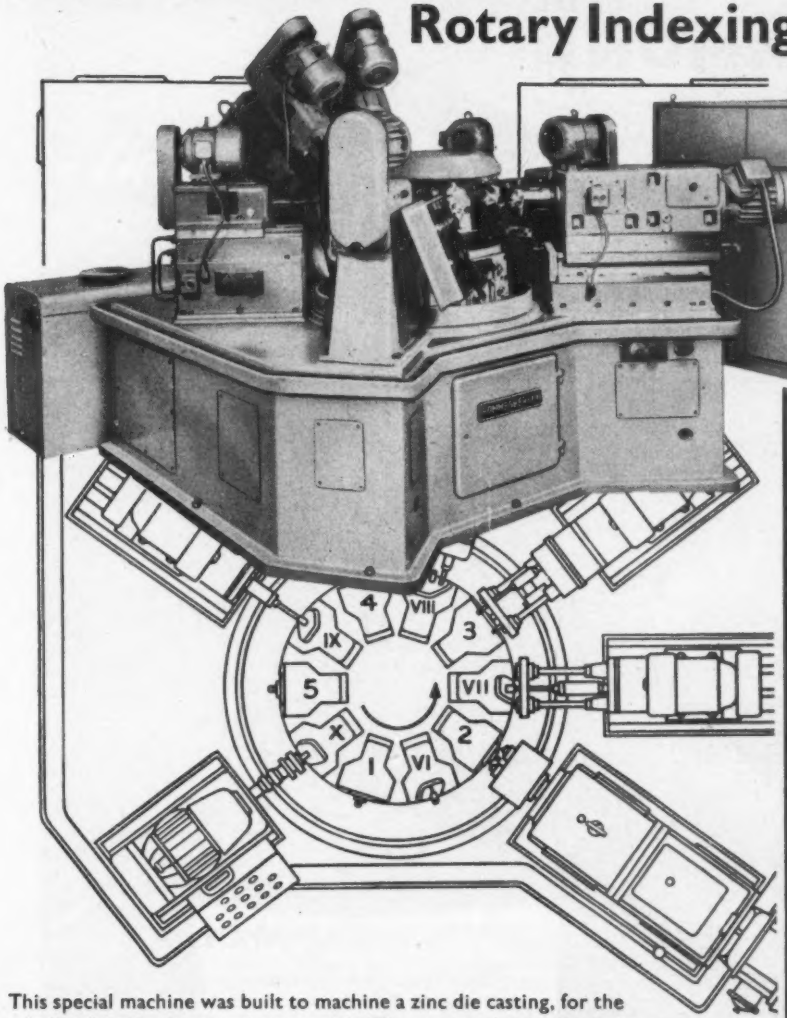
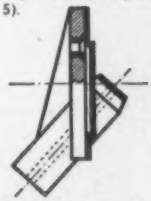
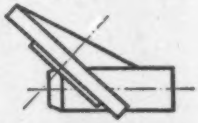


Casting loaded for machining during 1st rotation (stations I - 5).



Parts shown after 1st rotation (faced, drilled and spotfaced and milled).



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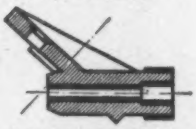

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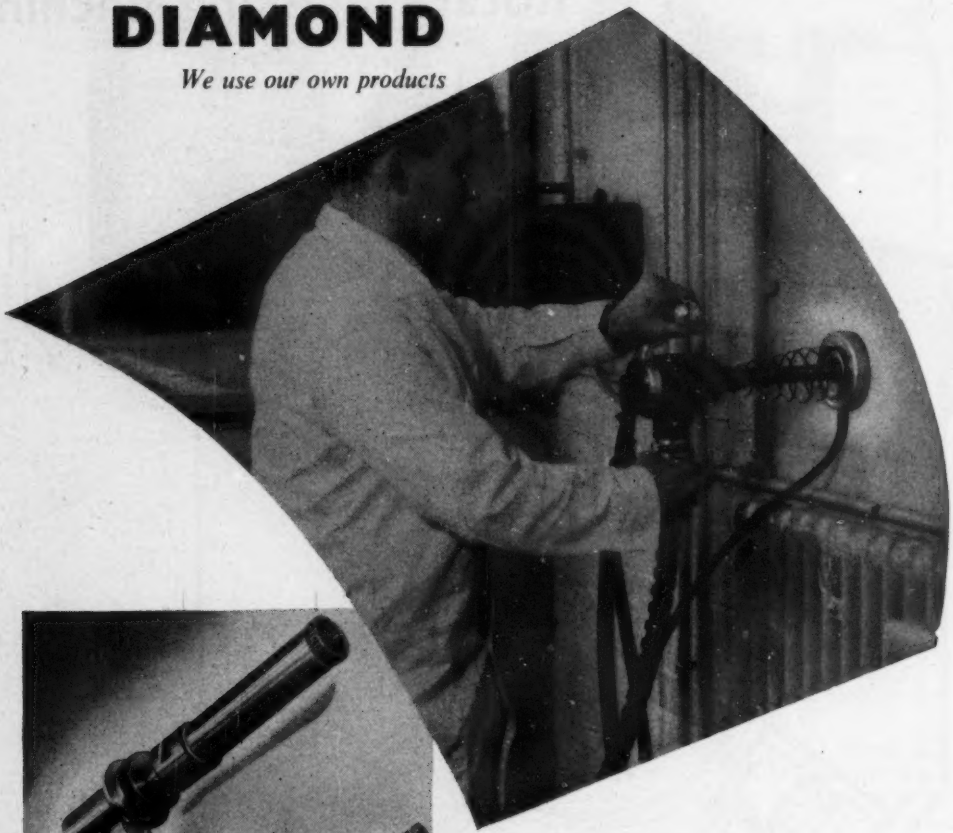
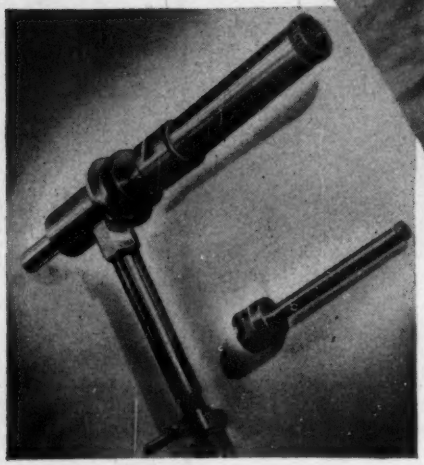
DIAMOND *cut* DIAMOND

We use our own products





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JW 6 OUR ILLUSTRATED DATA SHEETS AND OUR TECHNICAL REPRESENTATIVES ARE AVAILABLE ON REQUEST

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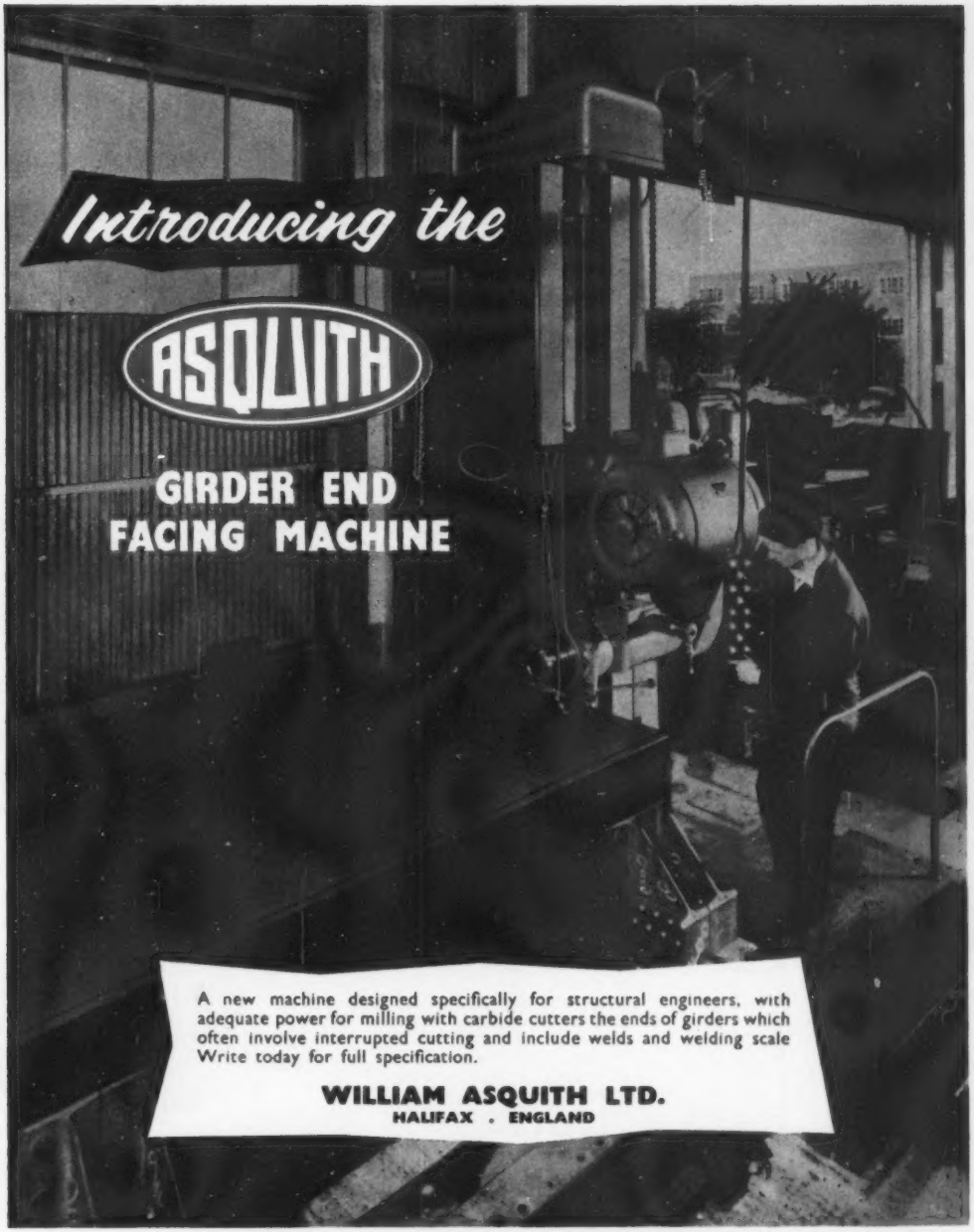
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ASQUITH
GIRDER END
FACING MACHINE
A new machine designed specifically for structural engineers, with adequate power for milling with carbide cutters the ends of girders which often involve interrupted cutting and include welds and welding scale Write today for full specification.
WILLIAM ASQUITH LTD.
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Sales & Service for . . . **DRUMMOND-ASQUITH** . . . the British Isles

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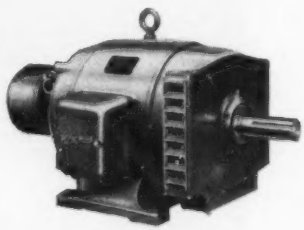
Newman

IN STEP WITH PROGRESS

Drip Proof up to 600 h.p.

Whilst Newman are proud of the many new developments they have introduced in electric motor design over the past few years, equally important is the progress the Company has made in extending its existing ranges.
An important step has been the addition of larger frames to the standard drip-proof range. Newman can now supply drip-proof, squirrel cage motors from 1/6 to 600 h.p.



YET ANOTHER EXAMPLE OF THE NEWMAN PROGRESSIVE DESIGN POLICY

Newman

587

making the pace in motor progress

NEWMAN INDUSTRIES LIMITED, YATE, BRISTOL

H.M.E

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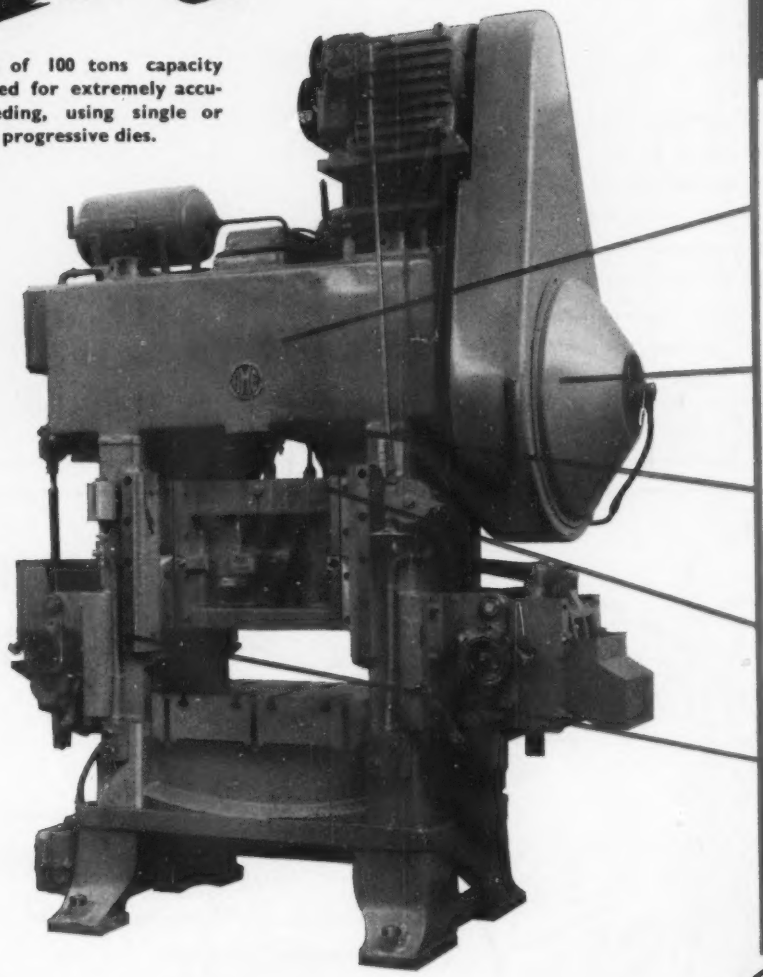
NEW 100 TON HIGH SPEED PRESS

A press of 100 tons capacity — designed for extremely accurate feeding, using single or intricate progressive dies.



Massive, box-type crown housing a heavy twin-throw, full eccentric crankshaft.

Electrically operated, single disc, pneumatic friction clutch.

Robust four-piece frame of tie-rod construction.

Variable speed from maximum to zero, and reverse, for easy tool setting.

Double roll-feed stock lubricator and buckle detector.

Circulating lubrication system.

Write now for details of this press. Our technical representatives are at your service for your full information.

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FASTER—SAFER TRIMMING!

(and simultaneous beading if required)

. . . on material up to $\frac{1}{32}$ in. thick
— corner radii from $\frac{1}{8}$ in.

S.M.G. Model BS. II is available for all shapes and sizes of drawn components available for trimming. Fitted with infinitely variable drive and precision gearbox offering high speeds. Smaller model also available. These machines bring you greater operating safety and high production rates. May we supply further data?

TRIMMING MACHINE

PEARSON PANKE LTD

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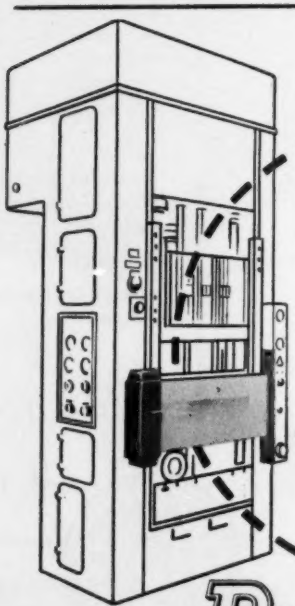
NRP



the **ES** **PHOTO-ELECTRIC** *Safety* **GUARD**

A light beam scans the danger area 100 x per second, ensures complete protection. As no mechanical force or time is required to operate the guard, the fatigue factor is reduced and output increased.

PROTECT THESE PRECIOUS THINGS

- ***Guard is automatically tested before every stroke.***
- ***Fine alignment is unnecessary.***
- ***Unaffected by external light.***
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NRP 1801

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Experience counts in every walk of life, but in no other job is experience so vitally necessary as in the design and building of machines such as large power presses, where the ability to turn out large numbers of high quality pressings at an economic rate depends so much on inbuilt robustness, accuracy and reliability.

The up-to-date design and extra massive proportions of all C.W. presses are not the sole features which give C.W. presses their absolute dependability but it is also the real old fashioned craftsmanship such as the accurate hand scraping of every slideway and the careful bedding of every main bearing that makes the difference between a COWLISHAW WALKER POWER PRESS and just another press.

COWLISHAW, WALKER & CO. LIMITED

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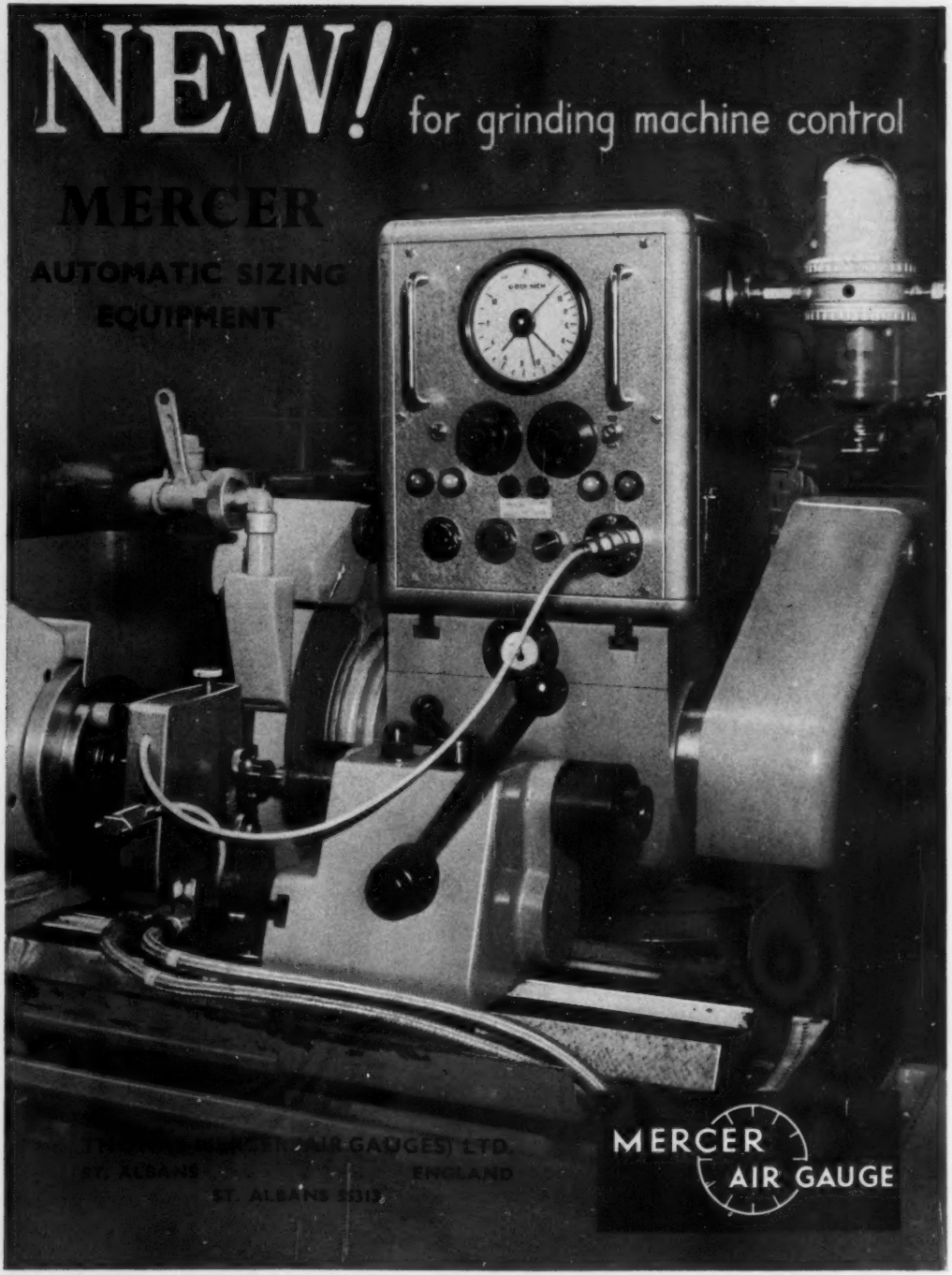
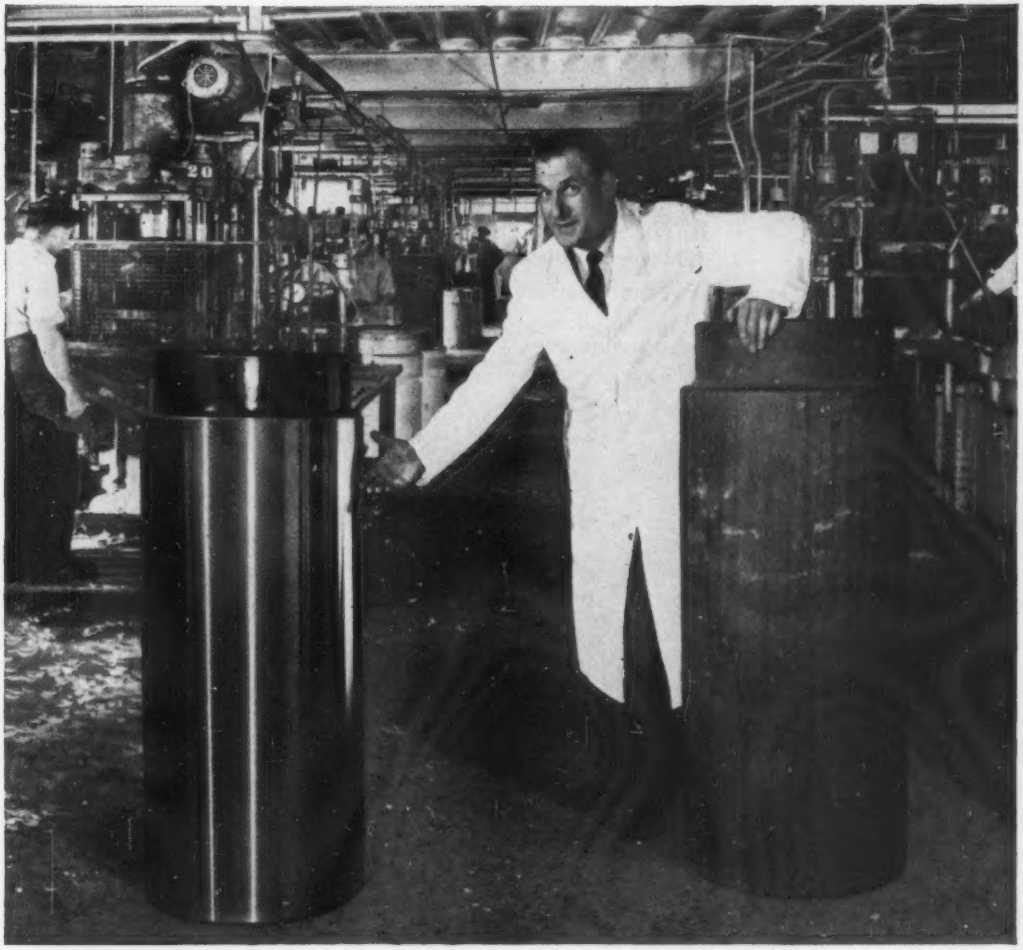
LONDON OFFICE : 17 Victoria Street S.W.1 Telephone : ABBey 6693


NEW! for grinding machine control
MERCER
AUTOMATIC SIZING
EQUIPMENT
MERCER
AIR GAUGE



See what Fescol can do

Here's the perfect before and after story of the Fescol process. The ram on my left is untreated, and has become corroded and pitted by wear and corrosion, in this condition it has reached the end of its useful life. Now look at the other ram, it was just the same before it was 'Fescol'-ised and now it will retain its new look almost indefinitely. That's because the nickel or chromium protection provided by the Fescol process withstands wear and corrosive attack being an even harder, more durable surface than the original metal. The process has proved so successful in the salvage of worn rams that now we have them treated before installation. Then we more or less forget about them.

If you would like to know more about the Fescol process of electro-chemical deposition, and its applications in a variety of industries, please write for publication M.9.

FESCOL

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Established 1920

Sole Licensees for Australasia: De Havilland Aircraft Pty. Ltd., Milperra Road, Bankstown, N.S.W.

TGA 959

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ROUNDNESS MEASURING INSTRUMENT

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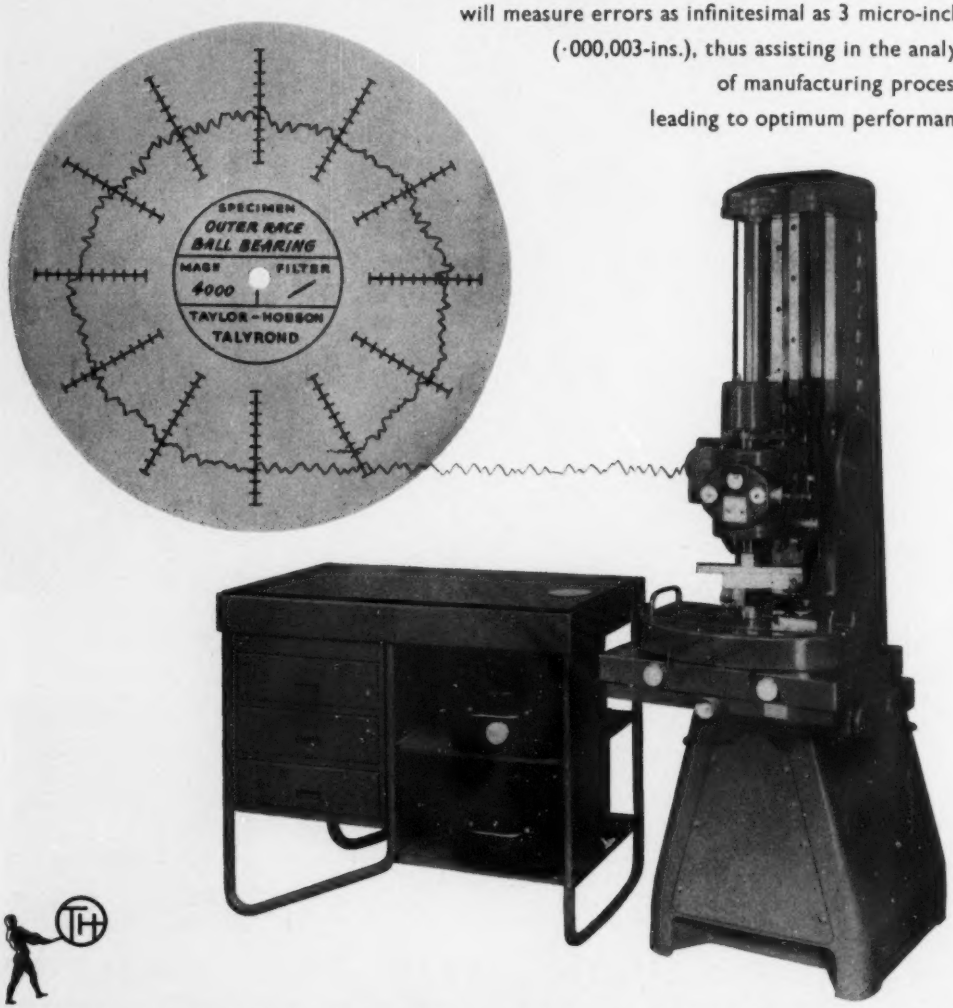

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Illustrations: Bridge Reamer and Structural Drill superimposed on a photograph taken during the erection of the Melting Shop at the Lackenby Steelworks of Dorman, Long & Co. Ltd.

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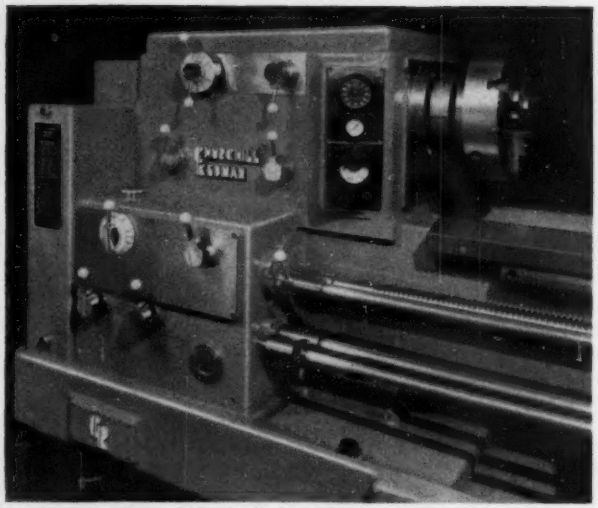

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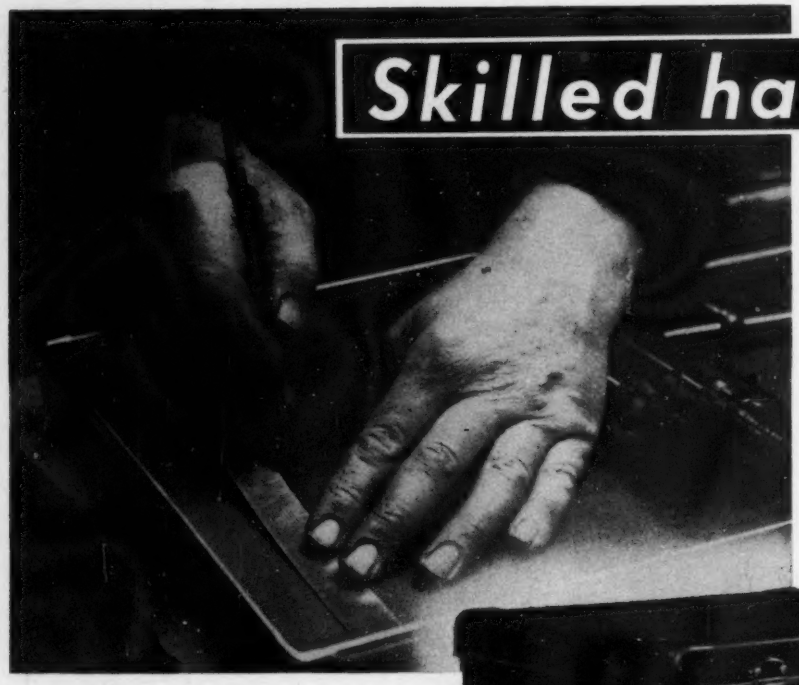

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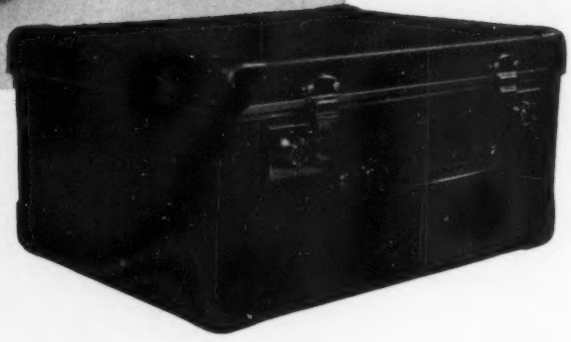

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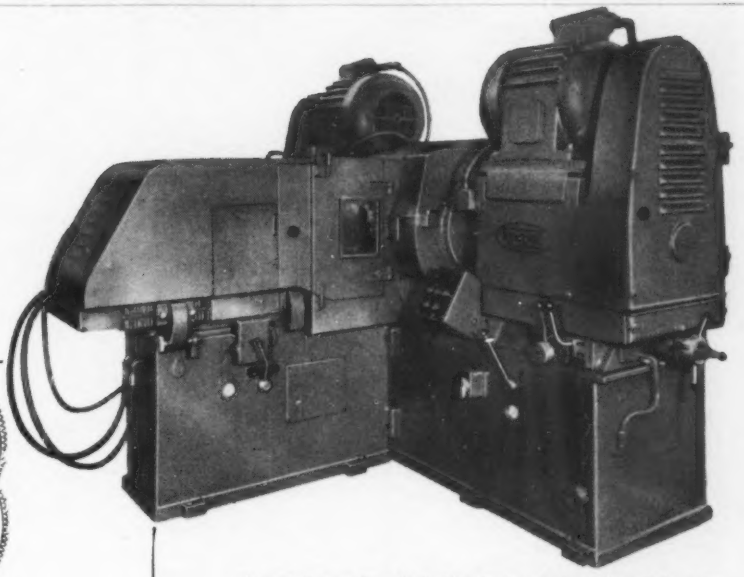

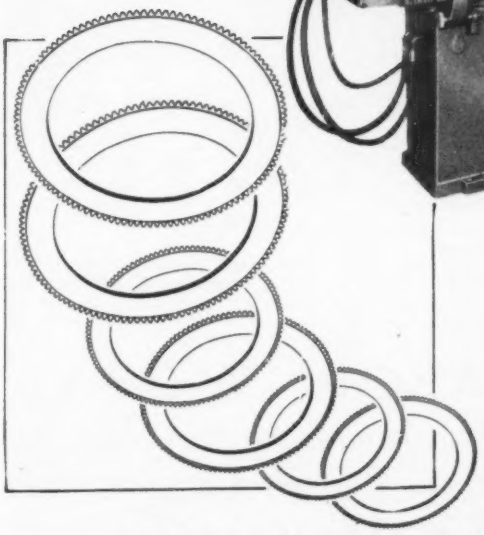

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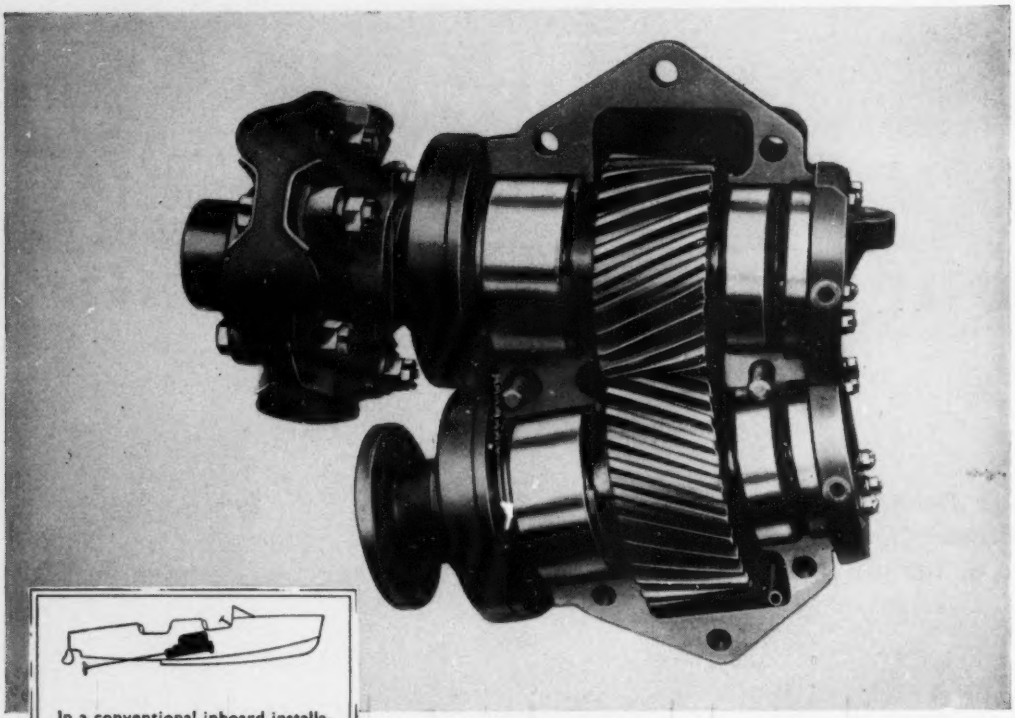
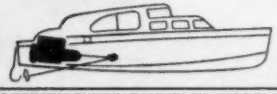


In a conventional inboard installation (above), the engine must be mounted in the centre of the boat with a direct drive to the propeller. Mounting the engine in the rear of the boat (below) greatly increases cabin space and hold capacity. Gleason engineers assisted the Marine Engine Manufacturers in the development of the V-drive.



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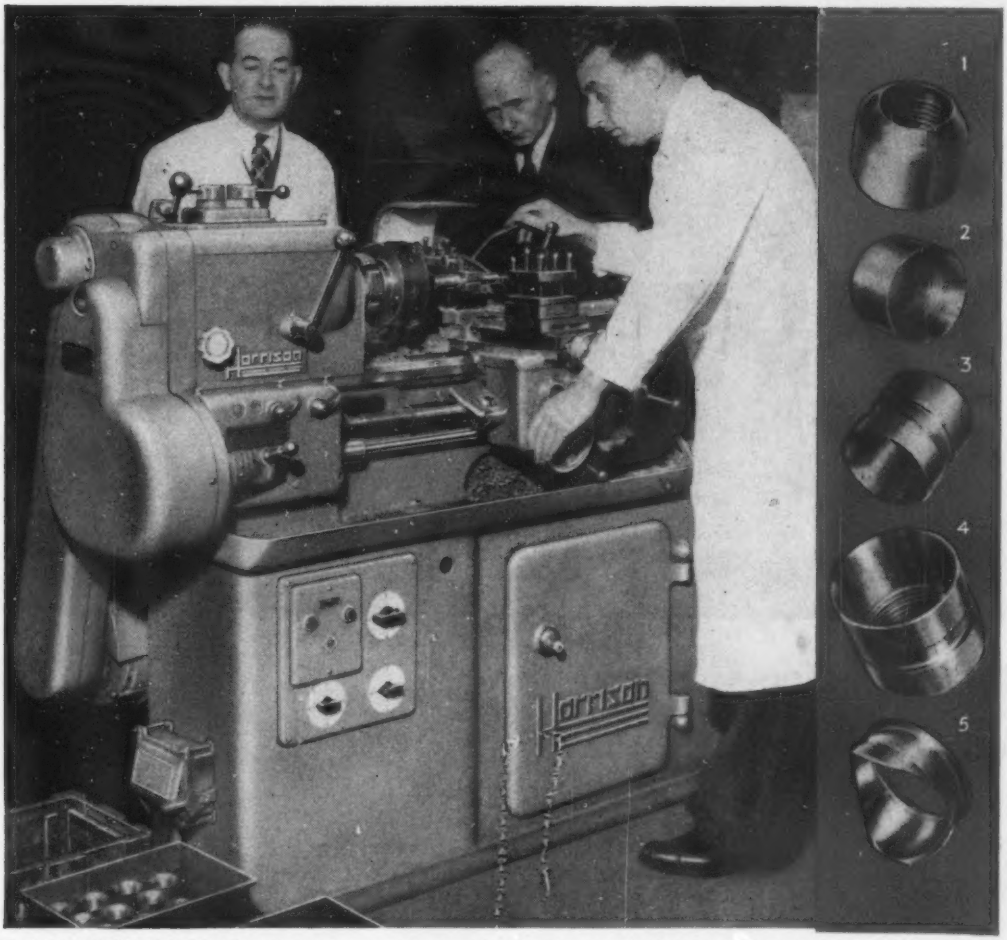

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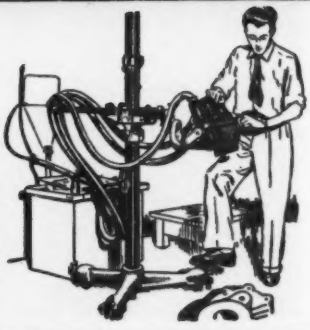

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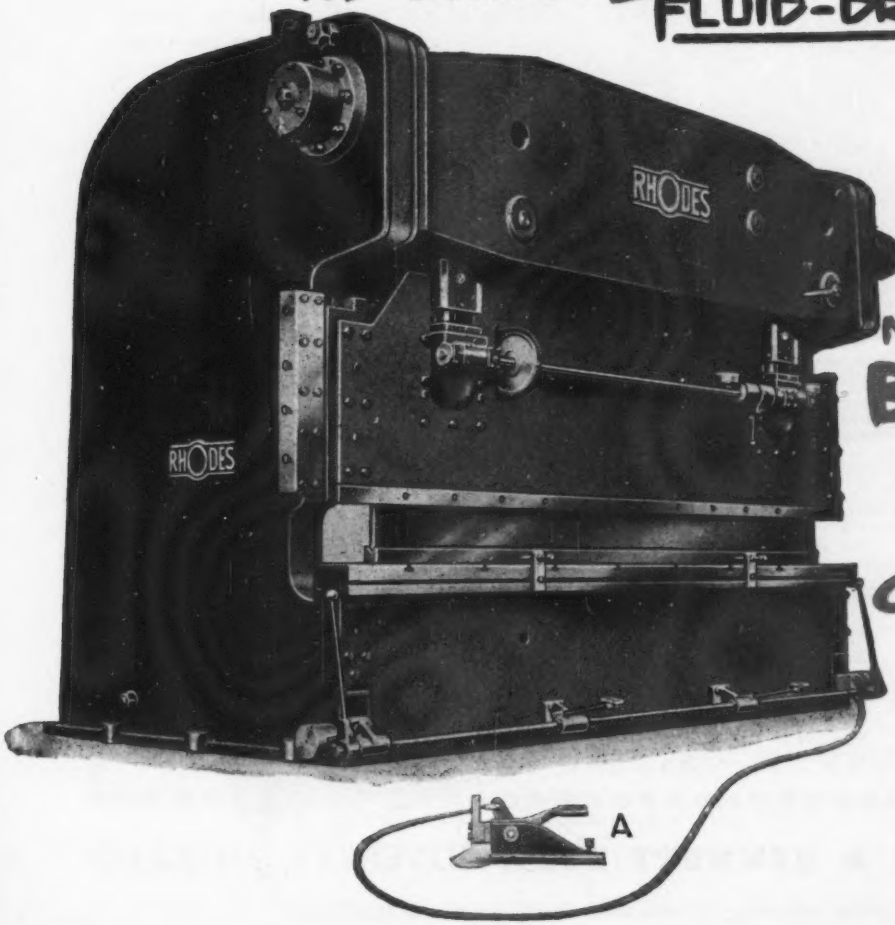

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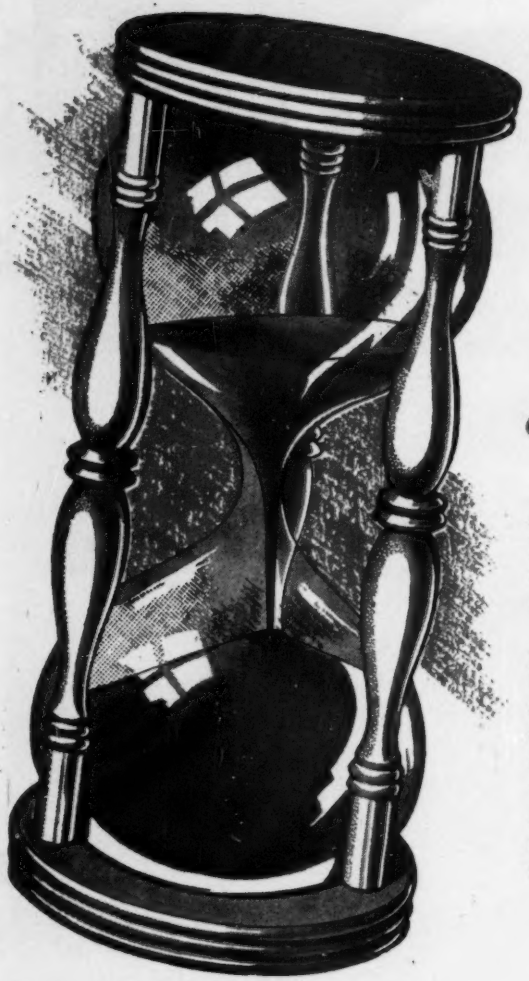

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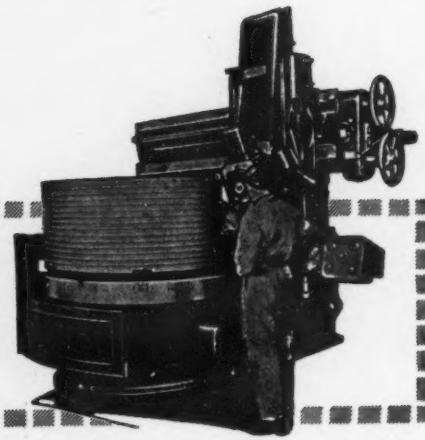

The illustration shows a Webster and Bennett 60″ Boring and Turning Mill at the Bradford Works of Crofts (Engineers) Ltd., machining a 60″ diameter vee groove pulley with a face width of 26″ having 18 grooves 1¼″ wide by 1¼″ deep.

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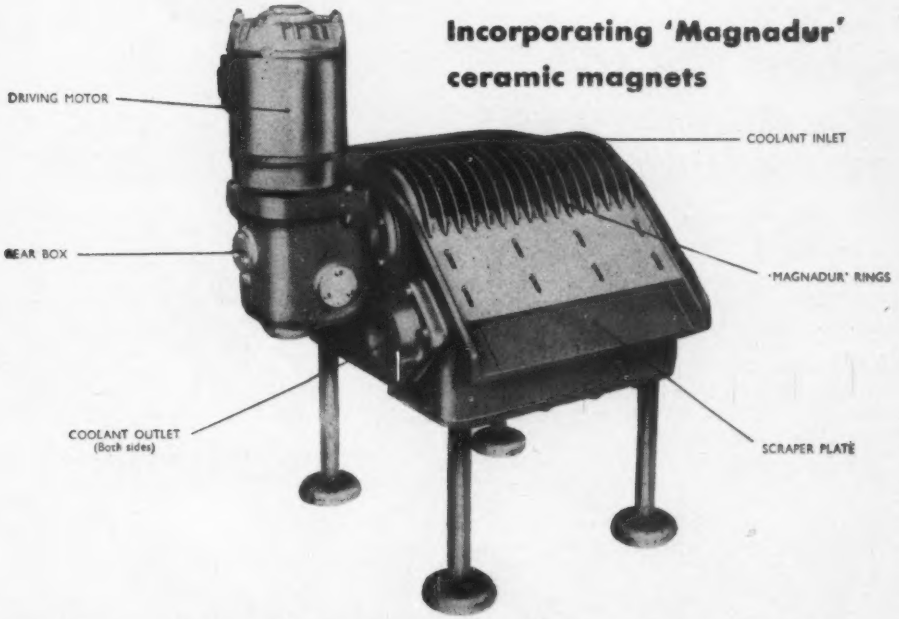

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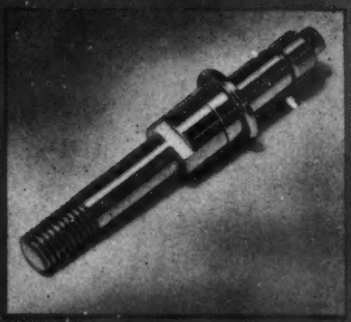

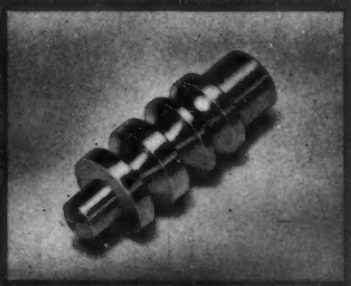

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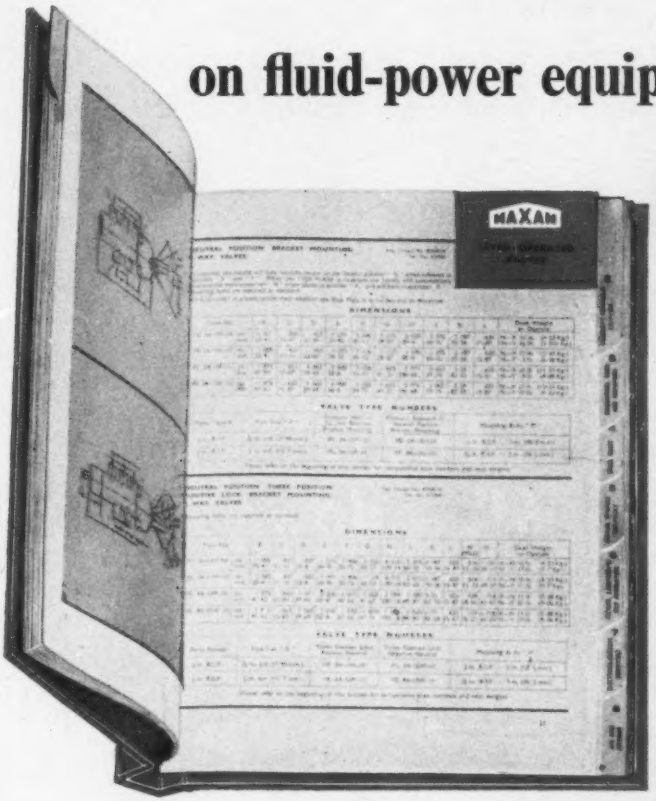

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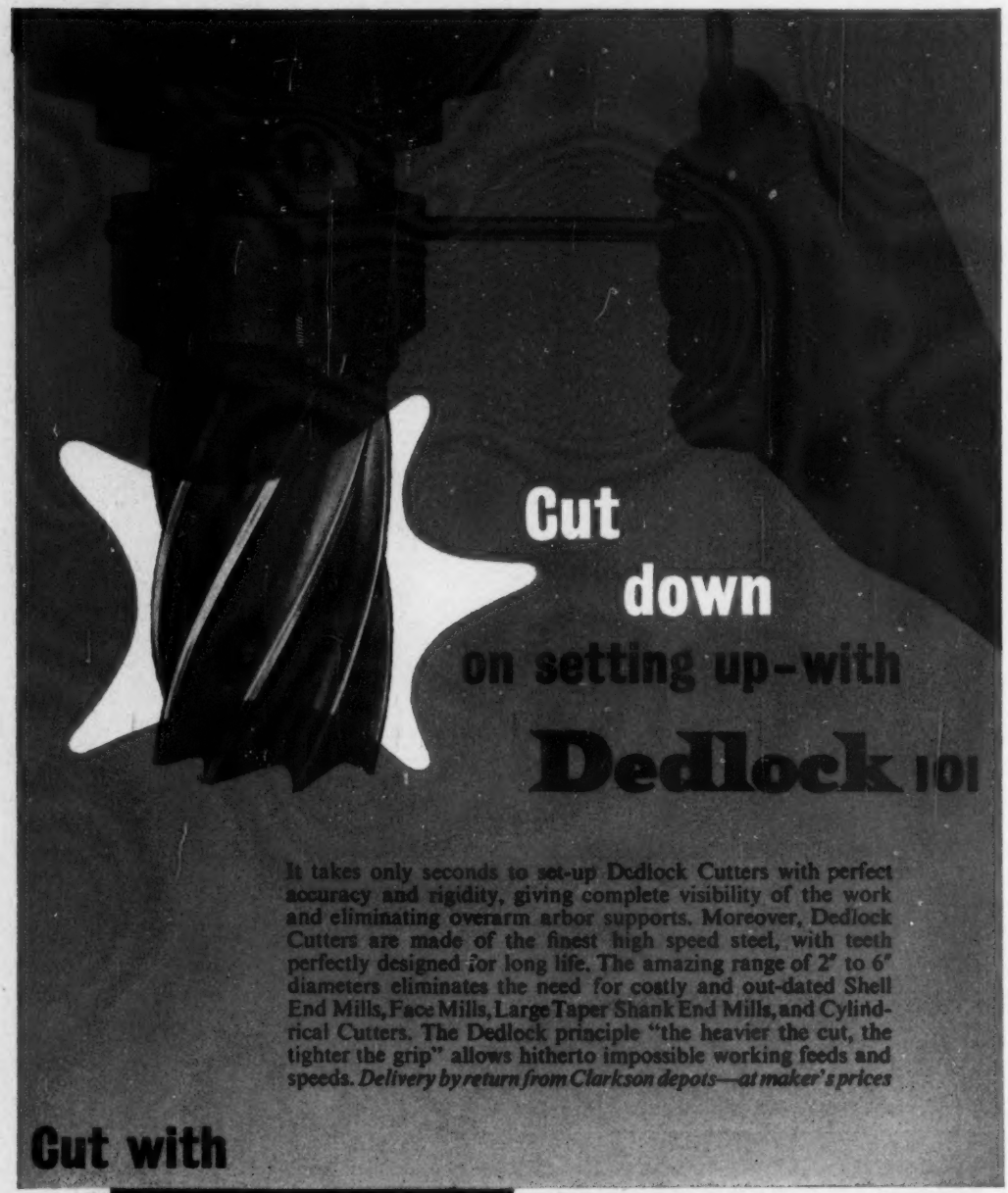

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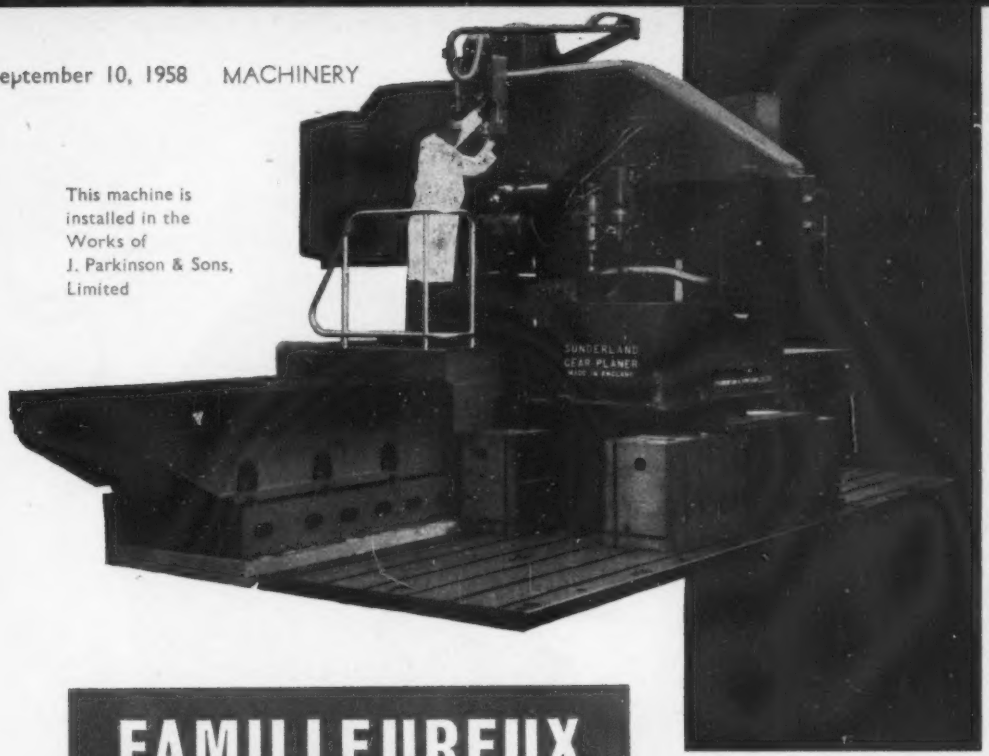

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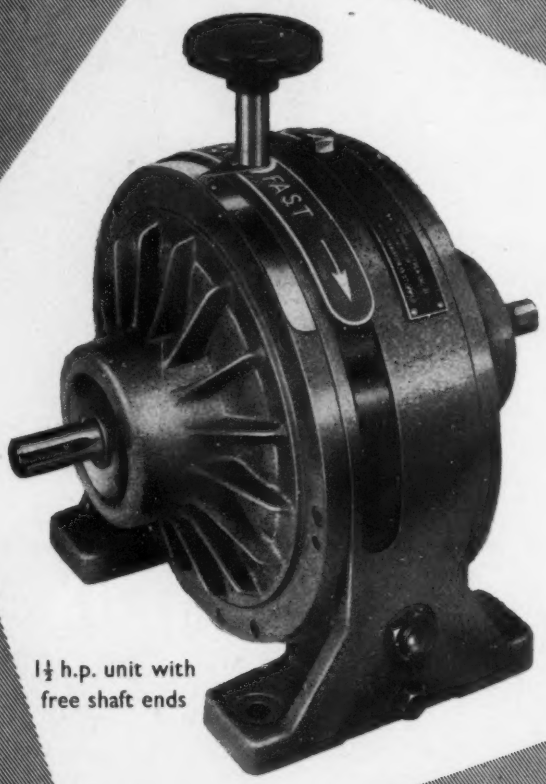

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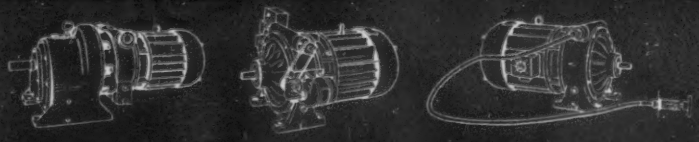

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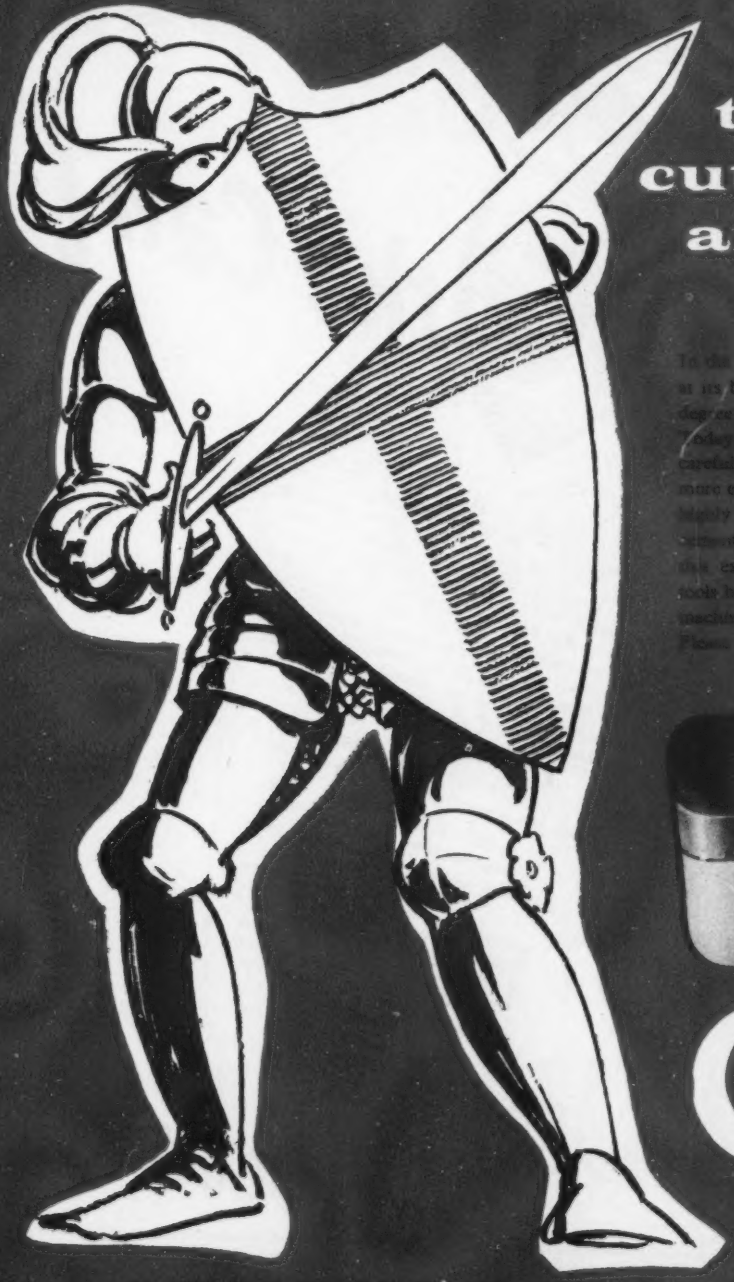

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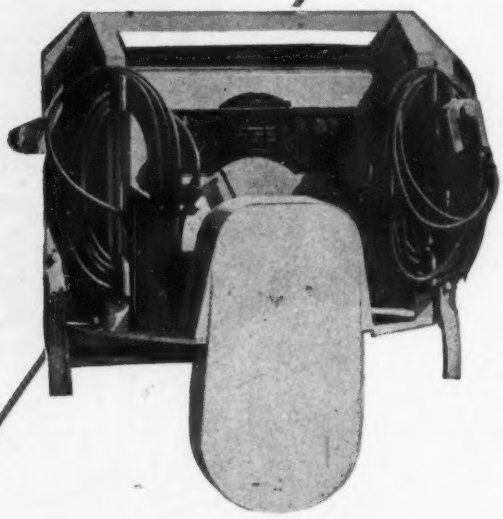

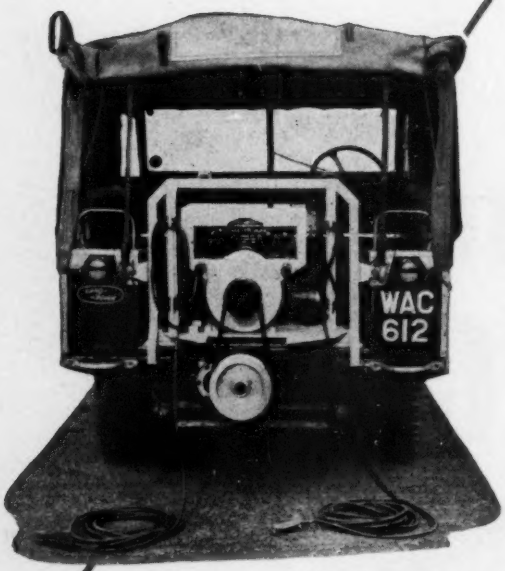

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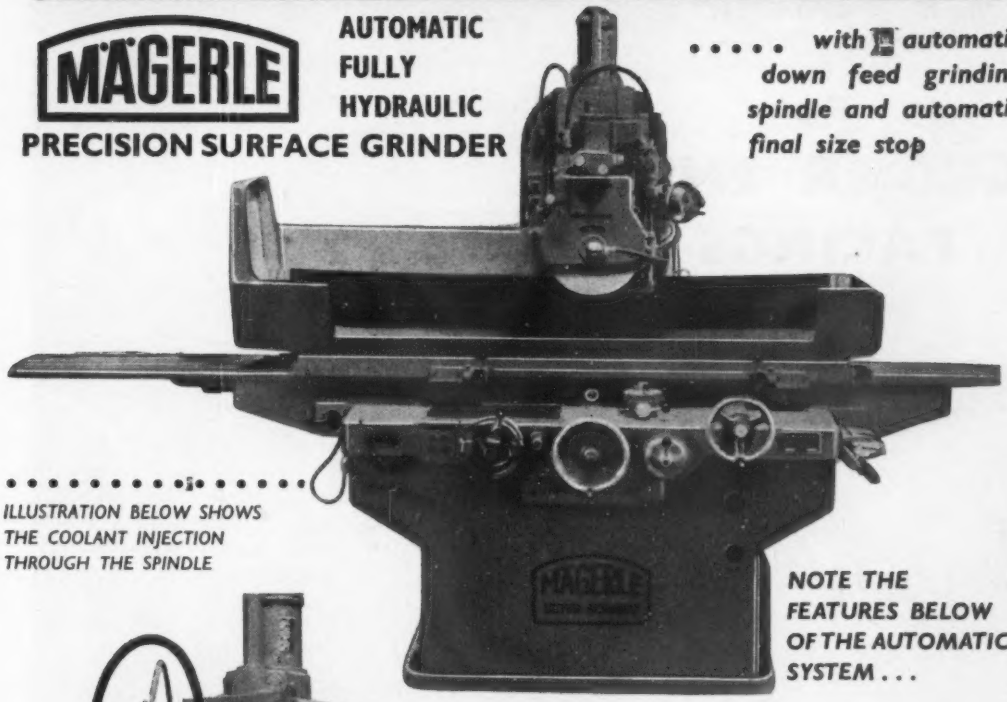

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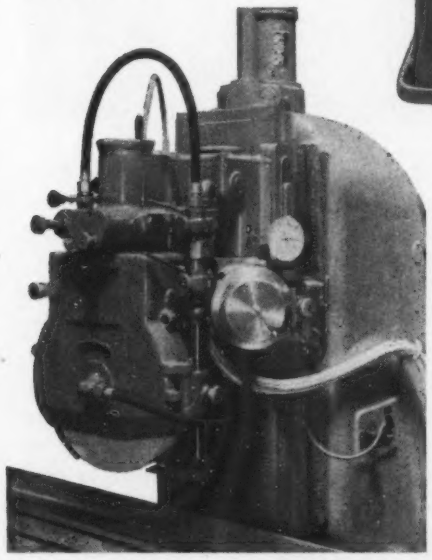

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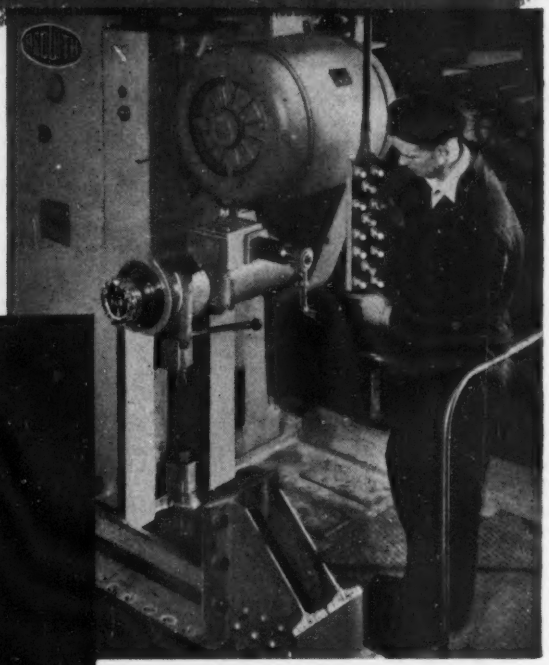

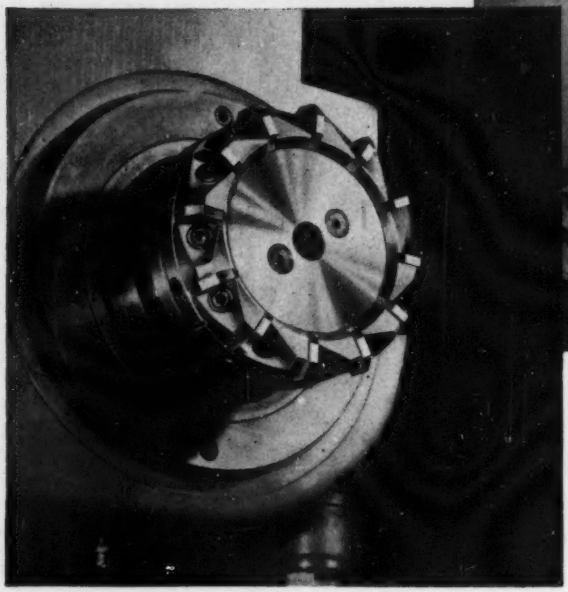

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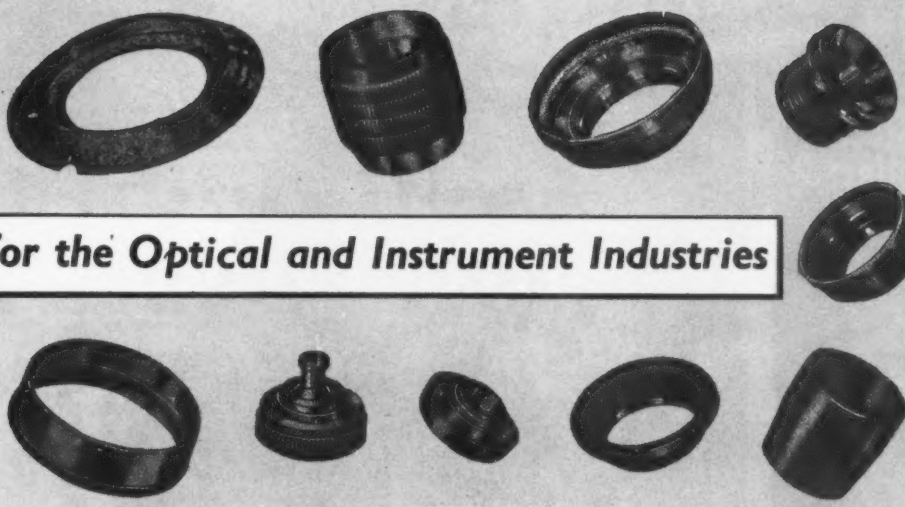

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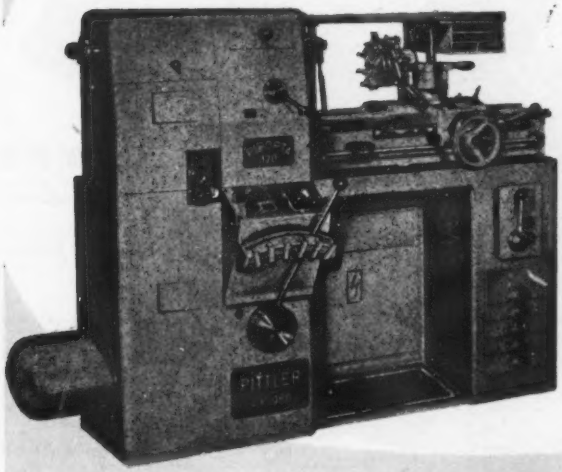

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MACHINERY

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Abstracts of Principal Articles

Aspects of Russian Engineering Industry P. 572

This sixth article in the series devoted to the engineering industry of the Soviet Union is concerned with the organization and activities of the Central Experimental Scientific Research Institute for Metal-working Machines, commonly known as ENIMS. Situated on the outskirts of Moscow, this institute has some 900 employees in the main research departments and design offices, and a further 1,300 are employed in an associated machine building plant. The institute is organized in three divisions, concerned with research, technology and design, and has been responsible for the development of the programme control systems of many of the latest Russian machine tools, including those exhibited at the Brussels fair. Among other fields of activity of the institute may be noted the development of spark machining equipment, plant for hot rolling gears, bevel gear cutting and grinding machines, the design of transfer machines particularly those for workpieces that must be rotated during the machining operations, and special dynamic balancing equipment. There is a well-equipped, air-conditioned measuring laboratory at the institute where work for industry is carried out, and special precision scales for programme control systems are produced. (MACHINERY, 93—10/9/58.)

Performance Tests for Balancing Machines P. 583

This article is the first of two devoted to a discussion of the performance tests which may be applied to dynamic balancing machines. Details are given of the dimensions of a series of test rotors for use during the investigations, also other equipment such as scales and dial indicators, and a description is included of the shaker table on which the balancing machine is mounted during the tests. Various states of unbalance of the test rotors are described, also the methods for separating the effects of unbalance in the two correction planes. Sections are devoted to accurate amount indication, accurate location of angle, and the effects of extraneous vibrations, and suggested layouts are included for the forms on which the data collected as a result of the tests can be entered. (MACHINERY, 93—10/9/58.)

Developments in Fraser Unit Head Machine Tools .....P. 594

The firm of Douglas Fraser & Sons, Ltd., Arbroath, is steadily extending its activities in the machine tool field, particularly as regards the building of unit head machines for high-production applications. Typical machines are described which are being built for supply to leading British and French motor-car manufacturers, and other firms, for such operations as facing and chamfering inner and outer tubes for steering column assemblies; milling and centring main transmission shaft forgings; and relieving operations on the bores of cluster gears. For operating the work-holding vices on these machines, the company has developed a standard torque unit, which incorporates a spring-loaded axially-moving wormshaft arranged to operate a limit switch when the required gripping force has been applied. A range of cam-feed drilling heads has been developed, with capacities for drilling up to 1¼ in. diameter in mild steel, and a range of milling heads with driving motors up to 20 h.p. will shortly be introduced. The company has designed a screw-operated electro-mechanical feed slide base which provides strokes up to 4 ft., and development work is in progress on a unit head incorporating two co-axial spindles for carrying out combined milling and drilling operations, for example. (MACHINERY, 93—10/9/58.)

Argo-Vac Vacuum Melting Furnace P. 601

Clino Foundry Supplies, Ltd., have recently introduced an indirect-arc vacuum melting furnace known as the Argo-Vac, which is suitable for all types of investment casting, including Shaw process and Investment-X, and casting in ingot moulds. With a capacity of 10 to 20 lb., the unit is completely self-contained, and in addition to vacuum melting, can be employed for de-gassing, and melting in an inert-gas atmosphere, such as argon. The melting capacity in air is 0·7 lb. per min., and in vacuum, 0·8 lb. per min. In a wide range of cast alloys, improved mechanical properties are obtained, notably ultimate tensile strength, elongation, and Izod values. (MACHINERY, 93—10/9/58.)

Setting Gauge for Grinding Operations on Internal or External Cones.....P. 615

Designed to facilitate setting up when grinding workpieces with internal or external conical surfaces, this gauge has a body which can be supported between centres, or mounted in the female taper socket of the machine spindle. A straight-edge is pivoted on the body, and can be set to the required angle by means of slip gauges in a similar manner to a sine bar. The table of the machine can then be adjusted to a corresponding angle with the aid of a dial gauge. (MACHINERY, 93—10/9/58.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

IN FORTHCOMING ISSUES

The production of automatic transmissions for motor cars—Wade furnaces for brazing stainless steel and heat-treating jet pipe assemblies.

Exchange of Technical Information

By reason of the increasingly exacting demands of product designers and the introduction of new metals, alloys, and other materials, manufacturing problems in the metal working industries tend constantly to become more complex. Apart, therefore, from the invaluable development work which is carried out by the suppliers of machines and equipment in connection with new designs and processes, and the activities of various research organizations, time and effort are being devoted on a growing scale, by small as well as medium-sized and large companies, to the solution of specific production difficulties. As the problems of production engineering multiply, moreover, so do the possible means whereby they may be overcome, and the day has long passed when a comprehensive knowledge of mechanisms would largely suffice. It may now be necessary to consider, in addition, electrical, electronic, hydraulic, or pneumatic systems, or the application of spark-machining, ultrasonic, chemical, or radio-isotope techniques, for example. It must be remembered, too, that important advances in the production engineering field are now taking place in an increasing number of countries.

In these circumstances it is inevitable that production engineering research—using the term in the broadest sense—should be constantly extending both in volume and scope, and activities under this heading may range from elaborate and lengthy investigations under laboratory conditions, to trials on a production line designed to achieve a better compromise between output rate and tool life. Many companies, in a given industry or in different industries, are necessarily confronted from time to time with similar problems, and it follows that —at least in non-totalitarian countries—there must often be much duplication of effort. As this situation is likely to be accentuated in the future, it is becoming more and more important that production engineers and others concerned with improvements in manufacturing practice should keep themselves informed of what has been done elsewhere.

When investigations undertaken by suppliers of machines and equipment are brought to fruition, efforts are naturally made to draw the attention of as many as possible of those who might be expected to benefit to the results that have been achieved. Data obtained by research establishments, except when working under contract for individual firms, may also be broadcast, or may have restricted circulation to members where work is carried out on a co-operative basis. For access to information derived by companies from independent research, however, the engineer must rely primarily on the goodwill and enlightened attitude of the managements concerned. Fortunately there is an increasing willingness to abandon the policy of secrecy in manufacture, which once widely prevailed, and to permit methods to be freely observed and described. It remains for the individual to avail himself of the opportunities thus afforded by the means which are open to him.

Much may be learned by visits to exhibitions, to research establishments which organize open days for this purpose, and to the works of other companies, either alone or as a member of a party. Attendance at meetings and conferences arranged by such bodies as the Institution of Production Engineers and the Institution of Mechanical Engineers is another fruitful source of instruction. Papers presented on these occasions are frequently of a high standard but they are sometimes so numerous that they cannot be read individually, and time for discussion may be drastically resistricted.

If he is not to be cut off from much news of potential value concerning the work that is being done by others in his field, however, the engineer must rely on such printed information as may be available to him. This may be provided in the form of laboratory reports, institution papers, articles in technical journals, or technical books. Because more and more data must be recorded, the volume of such printed material tends constantly to grow. The number of reports and papers increases, and fresh jounals are introduced to cover comparatively new and specialized fields. Frequently, therefore, the individual finds that he cannot devote time to the study of all the papers and journals from which he might reasonably expect to derive assistance in certain aspects of his work. The solution which appears to be adopted by some engineers in these circumstances is simple but hardly satisfactory. Unable to read all that comes to hand, and seemingly unwilling or unable to exercise powers of selection, they virtually abandon technical reading.

Production engineers who are so busy with the

(*Continued on page* 625)

Aspects of Russian Engineering Industry

Some Impressions Based on a First-hand Study of Soviet Plants

In this series of articles* devoted to the engineering industry of the Soviet Union, reference has been made to the growth of machine tool building in the U.S.S.R., and the organization and methods of the Ordzonikidze and Sverdlov machine tool plants have been considered. The Moscow Cutting-tool Works were described, and the last of the articles for which references are given was concerned with the work of the Central Research Institute of Technology and Machine Building (TsNIITMASh). This institute is situated in Moscow, and is one of many well-equipped and generously-staffed research establishments which serve Soviet engineering industry and have contributed greatly to its rapid expansion during the post-war years. Although TsNIITMASh engineers have developed certain new metal-cutting techniques and equipment, they are not concerned primarily with machine tool development, for which specialized research facilities are provided. One of the most important of these specialist establishments is the Central Experimental Scientific Research Institute for Metal-working Machines, Moscow, and the work of this institute is here described.

This institute is known generally by the abbreviated name of ENIMS, and reference has already been made in this series to its work, and to some of the machines that have originated from its design department, particularly in connection with gear cutting and grinding. Founded 25 years ago, the institute now has some 900 employees in its main research departments and design offices, and a further 1,300 workers are engaged in building production equipment at an associated machine tool plant. The institute is organized in three divisions, namely, research, technology, and design, and the work undertaken by these divisions will now be considered.

The research division is concerned with stress calculations for machine components, the elimination of vibration in machines, and the reduction of wear. Hydraulic laboratories under the control of this division are engaged in the design and development of new equipment, and after such equipment has been tested and approved, it is handed over to plants in various parts of the U.S.S.R. for series manufacture. A comprehensive range of hydraulic pumps and valves has been developed in the laboratory, and these units are now being produced in substantial quantities in three Soviet plants.

TAPE-CONTROLLED MACHINE TOOLS

In collaboration with the hydraulics laboratory, the electrical laboratory of the division is engaged in the investigation of the electrical control of machine tools powered by hydraulic motors and hydraulic cylinders. The electrical laboratory is

* MACHINERY, 93/4–2/7/58; 93/137–16/7/58; 93/288–6/8/58; 93/344–13/8/58; and 93/456–27/8/58.

intimately concerned with the development of new machine tool control systems and equipment and all switchgear for machine tools must be approved by the institute, prior to production. The laboratory was responsible for the design and manufacture of the control gear for the programme-controlled milling machine and lathe that are included in the Russian display at the Brussels exhibition. The milling machine is shown in Fig. 1, with the tape-reading unit at the right, and the cabinet of the latter unit has ample provisions for tape storage. Pull-out drawer-type chassis for the electronic equipment in the base of the cabinet, and the mounting of the tape deck on a hinged panel, facilitate servicing.

Basically a standard Gorki design, which has been modified by the institute, the milling machine has a 1,600 by 400 mm. (63 by 15¾ in.) table, and a cutter head which can be swivelled through 180 deg. It has a massively proportioned knee assembly, which is raised and lowered by a single feed screw, and is supported by two cylindrical bars at the front of the base. The power feed for the knee is retained for adjustment purposes, but the normal feed drives to the saddle and table have been disconnected and replaced by special variable-speed motor units. A similar motor unit has been fitted to the swivelling head, for traversing the spindle quill, the latter member, on the standard machine, being provided with hand adjustment only. The knee can be adjusted vertically through a distance of 420 mm. (16·53 in.), and the table can be traversed through 900 mm. (35.43 in.) longitudinally and 320 mm. (12·6 in.) transversely, the distance from the table surface to the spindle nose ranging from 30 to 520 mm. (1·18 to 20·47 in.). There are 18 spindle speeds from 60 to 3,100 r.p.m. Magnetic control tape is used, in conjunction with a simple type of digital computer, in which transistors are extensively employed.

Punched paper tape is adopted as the programme recording medium for the lathe, which is shown in Fig. 2. This machine is a Krasny Proletarii type 1K62 which has been adapted by the institute, and the floor-mounted programme control equipment is seen at the right-hand end of the bed. Access to the tape spools and sensing head is by way of a hinged door at the front, which incorporates a large glass panel. The control unit is connected to electro-magnetic clutches in the feed mechanism, whereby the slide and saddle motions are engaged, and a special stop unit has been fitted to the tailstock body to ensure that successive workpieces are machined from the same datum. Workpieces of 1,000 mm. (39·37 in.) maximum length can be turned, and the maximum diameter that can be swung over the bed is 400 mm. (15·75 in.). The 24 spindle speeds range from 12·5 to 2,000 r.p.m., and there are 48 rates of cutting feed from 0·075 to 4·46 mm. (0·003 to 0·175 in.) per rev. Metric threads of 1 to 192 mm. pitch, and English threads from 24 to 2 per inch, can be cut. The lathe is driven by a 14 h.p. motor.

TECHNOLOGY DIVISION

Investigations concerned with metal-working processes are undertaken by the technology division of the institute, and include those connected with the improvement of existing cutting tech-

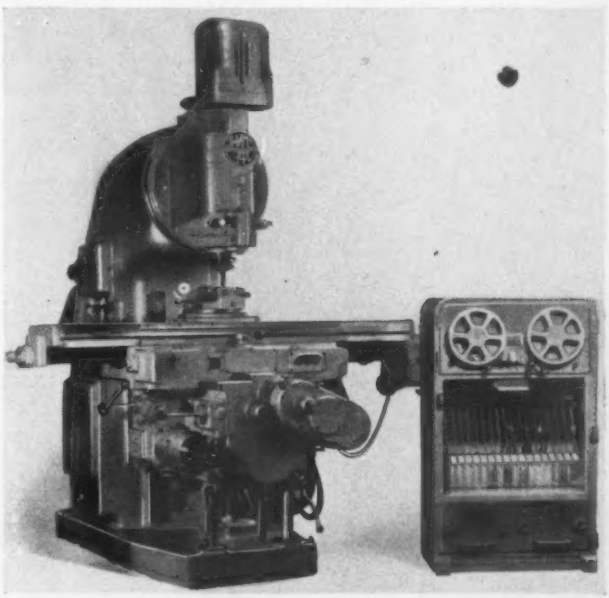


Fig. 1. This Tape-controlled Milling Machine is being Shown in the Russian Pavilion at the Brussels Exhibition. The Machine is a Standard Gorki Design which has been Modified by ENIMS, and this Institute was Responsible for the Design and Manufacture of the Control System

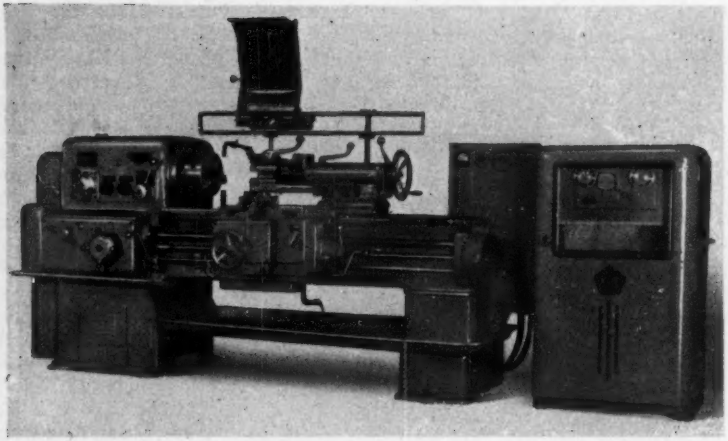


Fig. 2. Forming Part of the Russian Exhibit at Brussels, this Krasny Proletarii Lathe has been Adapted by the ENIMS Institute for Operation under Programme Control. The ENIMS-built Control Equipment Operates from a Punched Paper Tape

niques and the development of new methods. Current lines of research are concerned with the production of gears by plastic deformation, and the improvement of electrical machining processes. Considerable efforts have been made to speed-up spark-machining operations, and a technique has been introduced whereby an intense discharge, of short duration, is applied. It is claimed that the metal-removal rate obtained by the new method is approximately eight times as great as that which is possible with conventional spark-machining, but a rough surface is produced on the work. Equipment has been developed whereby the bulk of the material is removed by the new method, and normal spark machining is employed for finishing, so that a smooth finish is produced. A machine of this type is shown in Fig. 3, and is one of several spark-machining units that were being built and tested at the time of our visit. Electrode wear has also been the subject of investigation. It is stated that graphite electrodes are being used, and that their working life is 10 times as great as that of conventional brass electrodes.

Every new type of machine tool imported into the Soviet Union is sent to the institute for investigation and testing. A report on the design and performance of each machine is issued, and the institute is consulted before any further machines of that type are imported. The machine tool investigations are carried out in an

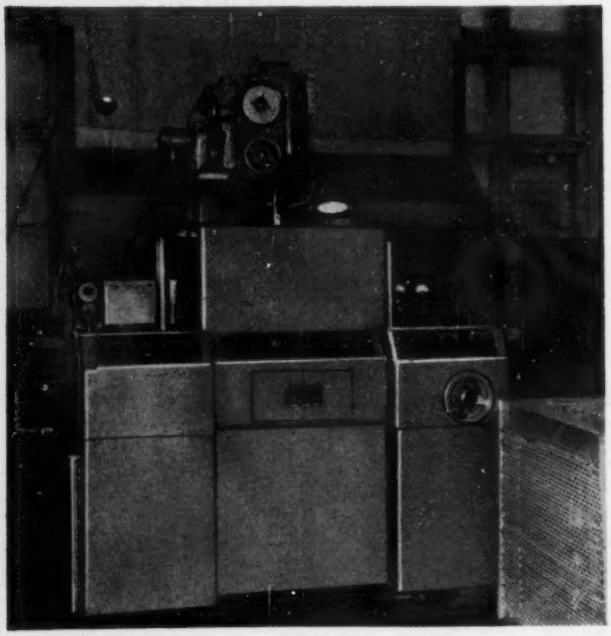


Fig. 3. This ENIMS Spark Machining Unit is One of Several that were under Construction in the Institute Workshops at the Time of Our Visit. Workpieces are Rough "Machined" by Means of a Series of Intense Discharges of Short Duration, and are Finished by Conventional Spark Erosion

extensive test shop, where large numbers of foreign machines were to be seen at the time of our visit. There was a large group of capstan, turret and copying lathes, and single-spindle automatics, which included machines by Index, Tarex, Gildemeister, Pittler and Fischer.

RUSSIAN TURRET LATHE

This department also undertakes the testing of all new Soviet-built machine tools, and the Russian-built equipment that was installed included the turret lathe seen in Fig. 4. The machine had been investigated and approved by the institute and is now in series production in one of the machine tool plants in the Urals. Workpieces up to 500 mm. (19·685 in.) can be machined over the bed, and up to 320 mm. (12·598 in.) over the cross-slide, the largest bar diameter that can be fed through the spindle being 85 mm. (3·346 in.). The maximum and minimum distances from the spindle flange face to an opposing flat face of the turret are 1,000 and 275 mm. (39·370 and 10·827 in.) respectively. Dead stop control and rapid power traverse, at a rate of 6 metres (19·685 ft.) per min., are provided for the turret and cross-slide saddles in a longitudinal direction, and these members have power feed traverse of 725 mm. (28·543 in.). The rates of longitudinal feed for both saddles range from 0·09 to 2·7 mm. (0·0035 to 0·106 in.) per rev., and for the cross-slide transversely from 0·045 to 1·35 mm. (0·0017 to 0·053 in.) per rev., the maximum transverse movement of the slide being 270 mm. (10·629 in.). A quick-release and indexing, 4-position tool post is fitted to the front tool station of the cross-slide, and all feeds can be pre-selected.

Pre-selection facilities are also provided for the spindle speeds, of which there are 12, ranging from 34 to 1,500 r.p.m. The spindle is fitted with an air operated chuck, and the machine is driven by a motor of 18·5 h.p.

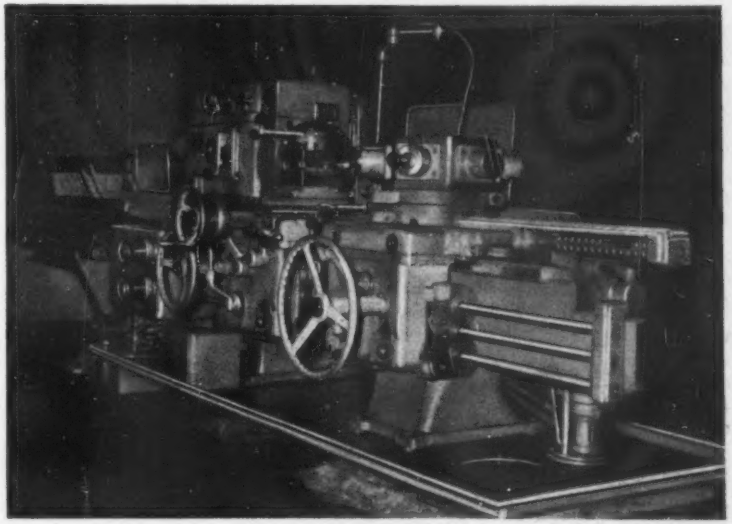


Fig. 4. All Russian and Imported Machine Tools are Tested by ENIMS, and a Soviet-built Turret Lathe is here seen in the Institute Test Department. It has Pre-selection Facilities for all Speeds and Feeds, and Dead Stop Control for the Turret and Cross-slide Saddles

LARGE TEST LATHE

At the time that this article was prepared, investigations were being carried out in the test shop in connection with the design of a large transfer machine for railway wagon wheel sets which is to be built by the institute in the near future. Tests were being carried out to determine the optimum conditions of cutting speed and feed when turning steel of 0·45 per cent carbon content, with a tungsten carbide tool. The large lathe employed for this purpose is shown in Fig. 5, and was designed and built by ENIMS specially for cutting investigations. It provides for machining workpieces up to 800 mm. (31·496 in.) diameter by 2 metres (6·56 ft.) long. Drive is taken from the large D.C. motor seen at the end of the headstock, and steplessly-variable speeds and feeds are provided by an electronic control system. A large control panel is mounted above the tailstock end of the bed, and incorporates dials to indicate the rates of speed and feed, also the power that is being absorbed.

The tests were being carried out to determine tool life and quality of finish with a cutting speed of 280 ft. per min., a feed rate of 0·031 in. per rev., and a depth of cut of 0·040 in.

During the course of our visit, one of the senior executives of the institute was asked to express an

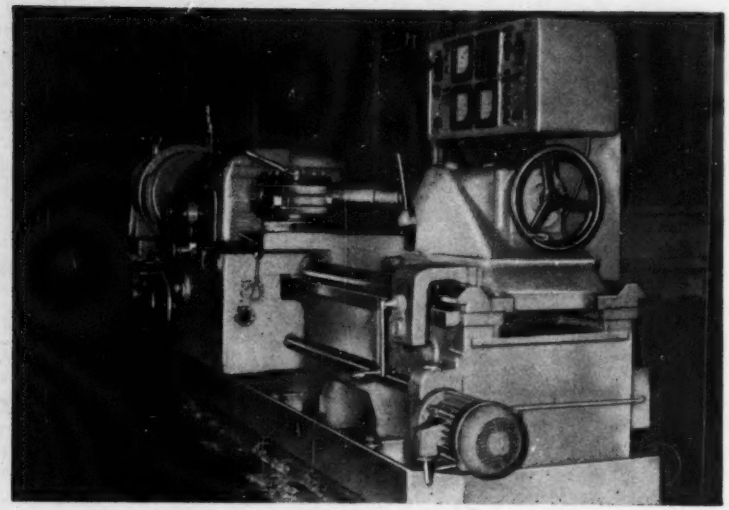


Fig. 5. For Cutting Tool and Machining Investigations, the ENIMS Institute has Designed and Built this Large Test Lathe. It is here Seen during the Course of Tests Connected with the Machining of Railway Wagon Wheel Sets

opinion on the design and performance of British machine tools. He stated that he considered many of the machine tool builders in this country had become static in outlook after the second world war, and, in consequence, their designs had tended to be conservative. The last M.T.T.A. exhibition had indicated that there had been many major advances in design, however, and, in his opinion, a further general improvement in machine tool design had taken place during the past year. This improvement, he considered, was due, principally, to the influence of American builders who had started to make their equipment in the United Kingdom, or had granted licences to British firms. In his view, some of our leading makes of turret and capstan lathes were very good, particularly with regard to the pre-selection of speeds and feeds, and he stated that many similar machines, with electro-magnetic clutches for speed and feed changing, were now being built in the U.S.S.R.—for example, the turret lathe shown in Fig. 4.

WORK OF THE DESIGN DIVISION

As its name implies, the main function of the design division of ENIMS is the development of new machine tools, but it only undertakes work of a type that requires considerable research which could not readily be carried out elsewhere. The division has a staff of 180 qualified machine designers, and it was pointed out in this connection that there are more than 8,000 designers specializing in machine tools in the Soviet Union.

ENIMS is the leading authority on machine tools in the U.S.S.R., and the designs of all new standard types must be approved by the institute before they are produced in large quantities. In order to avoid waste of effort, the initial schematic designs are submitted to ENIMS for approval, before the more detailed design work is undertaken. When a prototype has been built, it is examined by a committee, with an ENIMS representative, who usually acts as chairman, the other two members being nominated by potential users of the machine. There is no representative of the machine-building plant on this final proving committee, but before the prototype is submitted, a critical examination and an extensive series of tests are carried out by a committee from the plant where it is built.

Last year, the institute completed an extended design programme concerned with the development of a comprehensive range of machines for cutting and grinding spiral bevel gears. Reference has already been made to two of these machines in the first article in this series, also in the article devoted to the Ordzonikidze plant*, and one of the latest ENIMS spiral bevel gear generators is shown in Fig. 6. This machine has capacity for cutting teeth of 10 module, on workpieces ranging up to 800 mm. (31½ in.) diameter, and it is installed in the institute workshop for cutting gear components for the machines in the current building programme. As may be observed, it is fitted with a power-operated hoist to facilitate loading and unloading heavy workpieces. This unit consists of a beam assembly, which is free to pivot on a vertical pillar mounted on the cutter head of the machine. A steel cable, with a weighted hook at its free end, passes from a drum at the left-hand end of the beam, over a series of guide pulleys at the mid-position, and, thence, over a sheave at the right-

* MACHINERY, 93/137-16/7/58.

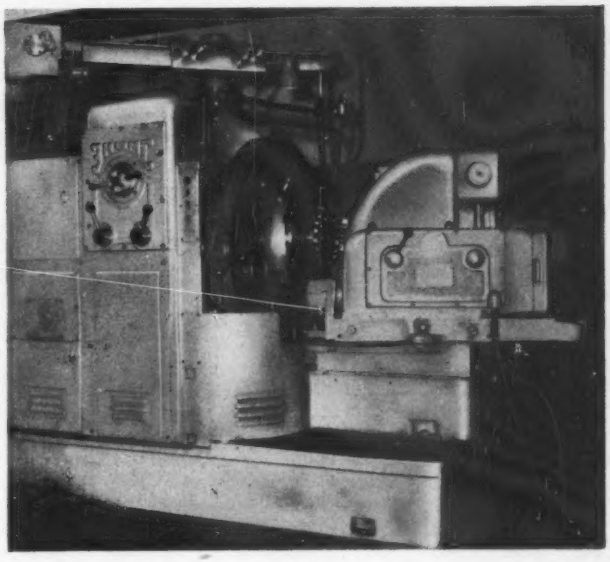


Fig. 6. ENIMS has Undertaken the Development of a Comprehensive Range of Machines for Cutting and Grinding Bevel Gears, and One of the Latest Spiral Bevel Gear Generators in this Range is Here Shown. It will Cut Teeth of 10 Module on Workpieces up to 31½ in. Diameter

hand end. The cable drum is driven by an f.h.p. motor, through a reduction unit.

Some details relating to the performance of gear cutting machines designed and built by ENIMS are given in a Russian article entitled *Automatic Machine Tools*, a translation of which has recently been made available under the Co-operative Translation Scheme, by D.S.I.R.*

It is pointed out that, at present, gears are usually cut on machines with relatively low cutting speeds (ranging from 33 to 82 ft. per min.), whereas, in contrast, the cutting speeds of lathes and milling machines are much higher (from 164 to 262 ft. per min. for equivalent materials). An automatic gear milling machine, type 5P325, has, therefore, been designed and when tungsten carbide-tipped cutters are used, cutting speeds up to 656 ft. per min. have been achieved. The time taken to cut a typical gear on the new machine is only 45 sec., and the operator is only required to load the workpieces. All other phases of the operation cycle are carried out automatically, including clamping, in-feeding, milling and retraction of the cutter.

Even higher speeds are employed on a machine (type 528) for cutting spiral bevel gears, and have ranged up to 984 ft. per min. A machine for cutting hypoid gears, designated type 525, which was tested recently, employs a mechanism which differs basically from that used for the Gleason system. High cutting speeds can be employed with this new machine, and idle time is reduced to a minimum of 2·5 sec. The machine is arranged to stop automatically at the end of the cutting cycle, and a conveyor is provided for swarf removal. Equipment is also being developed for the production of gear teeth by rolling.

The design division of ENIMS has also been responsible for the development of a range of dynamic balancing machines with capacities for handling workpieces weighing from 10 kg. (22 lb.) to 75,000 kg. (74 tons). A machine from this range is shown in Fig. 7, and is suitable for balancing components with a maximum weight of 18 tons. It is seen with a test-piece in position, and is intended for turbine components. The piece to be balanced is supported in half-bearings, which are mounted on top of columns, fabricated by welding from steel plate and sections. Both columns can be adjusted on the welded steel baseplate, and the workpiece is driven, by means of a universally-jointed telescopic shaft, from a variable-speed D.C. motor on the control unit, at the right. The control unit is separate from the bed plate, to reduce the transmission of vibration, and the D.C. supply is derived from a separately-mounted motor-generator. Electronic equipment of conventional design is incorporated for indicating the position and magnitude of the out-of-balance mass, and is housed in a separate cabinet at the top of the control unit, so that it can be removed readily for servicing.

In the article already mentioned, reference is made to the work of ENIMS in connection with the balancing of electric-motor armature shafts. It is pointed out that automatic lines for making such shafts have been in operation in Soviet factories for a number of years. Until recently, shafts produced on these lines were balanced on manually-operated machines. After it had been loaded, each shaft was run at 1,200 r.p.m., and the location of the out-of-balance mass was indicated by electrical instruments. The shaft was then transferred to a drilling machine, where the operator

* Stanki avtomaty by A. P. Vladzievskii: published in Nauki i Zhizn, 1956, 23 (7), 13 to 16. Translation (Serial No. CTS 350) available rom D.S.I.R., Charles House, 5-11 Regent Street, London, S.W.1. Price £1 12s.

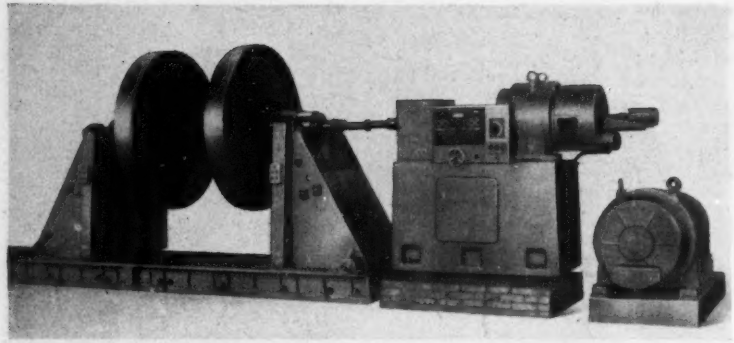


Fig. 7. This Large Dynamic Balancing Machine, with a Capacity for Workpieces with a Maximum Weight of 18 tons, is One of a Range that has been Developed by the Institute. It is Intended for Balancing Components for Turbines

machined a hole for counterbalancing purposes.

The balancing operation is now carried out automatically on a machine that has been developed by ENIMS. This machine replaces four universal balancing machines and drilling machines. The new unit measures and records the vibration of the component under test, and controls the depth of the drilled hole. It incorporates a special frequency filter for determining the amount of out-of-balance, and a number of other new electronic and tele-mechanical mechanisms to detect and correct the smallest tendency of the shaft to vibrate. An electro-hydraulic mechanism rapidly and accurately transfers and clamps the shafts.

An ENIMS balancing machine of the type described is shown in Fig. 8, and an automatic transfer line incorporating a similar unit will be considered in the next article in this series.

SPECIAL-PURPOSE AND TRANSFER MACHINES

The design division of the institute has been closely associated with the development of special-purpose and transfer machines in the Soviet Union. Design of unit heads for use in special-purpose drilling and milling machines was initiated in 1933, and the first heads were built in the following year. Subsequently, standard machine elements of various types were introduced—including heads, pedestals, columns, and beds—also standardized control units, fixtures, and clamping arrangements were designed and built. The first unit construction machine tool was built in 1934, and provided for drilling holes in both sides of the differential casings for ZIS lorries. Until 1946, ENIMS and its associated plant provided the only facilities for the design and construction of unit-type machine tools in the Soviet Union, and a total of more than 1,600 different types has been built. A typical machine, incorporating three standard ENIMS heads, is shown in Fig. 9, and provides for drilling 73 holes in cylinder blocks for motor-lorry engines.

Towards the end of the second world war, ENIMS started to design automatic transfer machines embodying standard units, and the first transfer machine was completed in the institute plant in 1946. Of the in-line type, this machine was installed in the Kharkov Tractor Factory, and had 14 unit heads with multi-spindle adapters for a total of 134 cutting tools. There were seven working stations, at each of which there were two heads, one on each side of the transfer ways. The machine provided for drilling and tapping cylinder blocks, which were moved along the transfer ways by pawls on a hydraulically-operated shuttle bar. Motors with a total of 162 h.p. were fitted, and it is stated that the output of cylinder blocks was increased 10 times.

Four other transfer machines were built in the institute machine tool plant, and one of these machines, for use in the Minsk Tractor Factory, is shown in the heading illustration of this article. It has 33 machining stations, and performs all the drilling, milling and similar operations on cylinder heads for the KD 35 tractor engine, one machined head being delivered every 1½ min. The machine is divided into four independent sections, which can be operated separately or simultaneously, and the sections are connected by transfer and turn-over units. A total of 265 cutting tools is used, and the electric driving motors have a combined output of 192 h.p. Workpieces are moved along the transfer ways of the machine by a hydraulically-actuated shuttle bar, and the heads have hydraulically-powered traverse motions. The fixtures at each machining station incorporate hydraulically-operated clamps, and swarf is carried by screw-type conveyors, below the transfer ways, to slat-type discharge conveyors at convenient positions. It is claimed that the introduction of this transfer machine has enabled 224 operators to be freed for other duties.

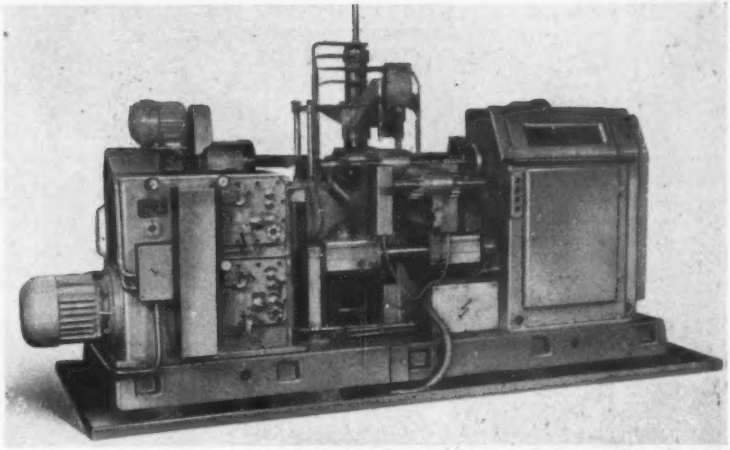


Fig. 8. ENIMS has Developed Automatic Machines for Dynamically Balancing Rotor Assemblies for Electric Motors and Drilling Correction Holes. Equipment of this Type is Shown Above, and is Intended for Incorporation in an Automatic Transfer Line for the Production of Complete Rotor Assemblies

As the capacity of the ENIMS machine tool plant was not equal to the increasing demand for transfer machines, the building of certain types of these machines was transferred to the Ordzonikidze Machine Tool Plant late in 1946. A section of the design office, all drawings and technical data, and a certain number of experienced engineers, were moved to this factory, which has since undertaken the building of transfer machines for "static" parts, this term being applied to those workpieces that remain stationary during the machining operations. In consequence, the institute has been free to concentrate on the development of automatic transfer lines for the production of parts that must be rotated during the machining sequences—for example, shafts and gears. For the sake of convenience, such machining lines will not be considered at this stage, but certain of the automatic installations designed and built by ENIMS will be discussed in some detail in the next article in this series.

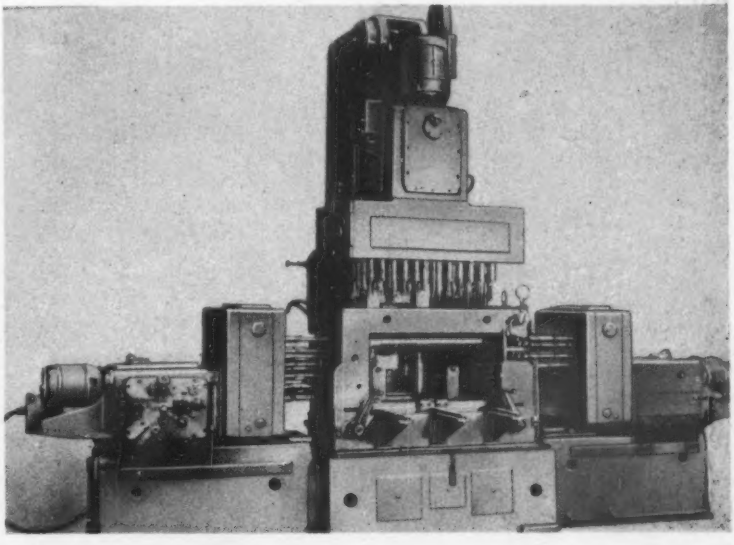


Fig. 9. Since 1933, the Institute has Designed and Built Standard Unit Heads and Machine Elements. This Representative Special-purpose Machine Incorporates Three ENIMS Heads and Other Standard Units and Provides for Drilling a Total of 73 Holes in Motor Lorry Cylinder Blocks

PRECISION MEASUREMENT LABORATORY

Most of the laboratories and technical offices are housed in an impressive building of four storeys, which extends along the road frontage of the institute site. This building is separated by gardens from the experimental shops and machine building works at the rear. Among the laboratories in the

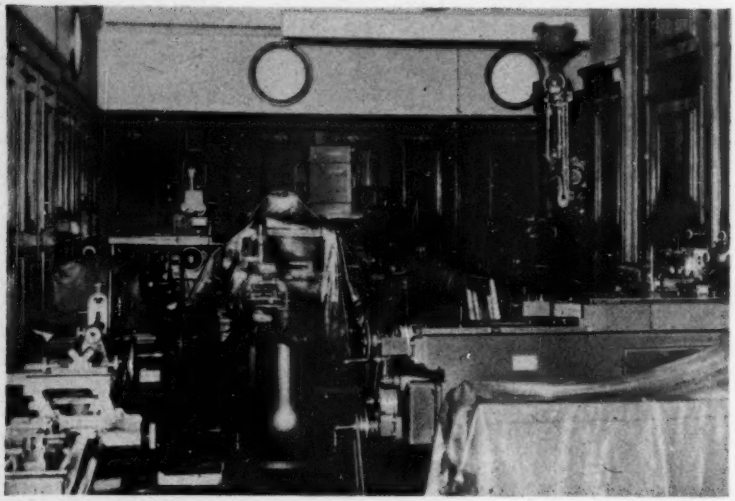


Fig. 10. The Precision Measurement Laboratory of the ENIMS Institute, which is Surrounded by a Corridor for Insulation. A Controlled Atmosphere is Provided, and the Temperature is Maintained at 20 deg. C. Within Very Close Limits

main building is one for precision measurement, and a general view of this department is given in Fig. 10. It has a controlled atmosphere, and the temperature is maintained at $20 \pm 0{\cdot}1$ deg. C., thermostat units being installed in each corner of the room. The laboratory is surrounded by a corridor, for insulation purposes, and access from the corridor is provided by two sets of double doors. A maximum of four persons is allowed to work in the laboratory at any one time in order to reduce the influence of body heat on the measurements that are being made. A large air conditioning plant, with fully automatic control, is installed on the other side of the corridor. Air is drawn from the laboratory and is mixed with air from outside the building in the proportion of 7 volumes to 3.

In addition to providing for the fine measurement requirements of the institute, this laboratory undertakes measurement work for industry. The equipment is of both Russian and foreign origin, and includes machines that have been developed by the institute for cutting special precision scales for programme control systems. Each scale takes the form of a very fine rack with a pitch of 0·05 mm. (0·002 in.), and it is stated that the pitch is held

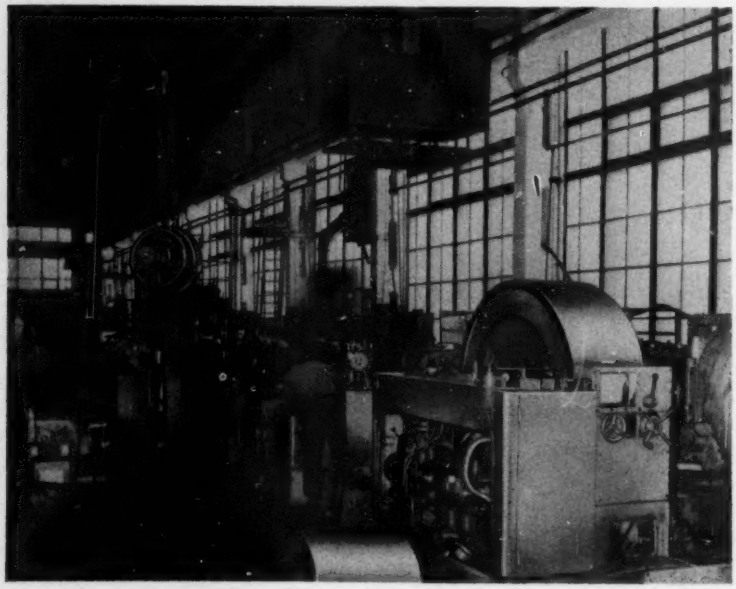


Fig. 11. Part of One of the Bays in the ENIMS Machine Building Plant. This Section is Devoted to the Construction of Machines for Cutting and Finishing Bevel Gears, and a Large Spiral Bevel Gear Grinding Machine is Seen Partly Completed in the Foreground

to within a tolerance of 1 micron (0·0004 in).

Among the projects that were being worked on in other laboratories in the main building at the time of our visit may be noted an investigation into the effect of misalignment and clearance on the loading of, and heat generated in, plain bearings; the development of high-speed grinding heads incorporating air bearings, with maximum spindle speeds of 50,000 r.p.m.; and the design and construction of a simple, inexpensive system of powered clamping for use on standard centre lathes.

ENIMS MACHINE BUILDING PLANT

As has already been mentioned, the machine building plant associated with the institute is one of the group of buildings at the rear of the front block. These buildings are of single-storey construction, mainly in reinforced concrete, and are well-lit by means of windows and roof lights. In common with all other plants in the Moscow and Leningrad areas, all the windows are double-glazed to insulate the interior from the severe cold in the winter months. The machine tool plant is arranged in three long bays, with travelling gantry cranes covering each bay, and Fig. 11 shows part of the bay devoted to the building of ENIMS bevel gear generating and grinding machines. The employment of a woman crane driver may be noted—as is general in Soviet workshops—and it is stated that 50 per cent of the employees in all grades throughout the institute and plant are women.

This section of the plant is engaged in the series production of various bevel gear machines for a total of six months each year. These machines are made in three sizes, with capacities for producing gears with maximum diameters of 855, 500 and 320 mm. (31·5, 19·7 and 12·6 in.) diameter, and smaller machines for gears up to 250 mm. (9·8 in.) diameter are built elsewhere, to ENIMS designs. The machine seen under construction in the foreground in Fig. 11 is for grinding spiral bevel gears up to 800 mm. diameter, and it may be recalled that reference was made to this machine in the first article in this series.

An experimental gear rolling machine is shown in Fig. 12 and h.f. induction heating is employed to raise the workpieces to the required temperature for forming the teeth. This machine has been designed and built by the institute, and incorporates two rolling heads of massive construction, which are supported at the top and bottom by horizontal slideways. Each head can be moved inwards or withdrawn, for setting purposes, by means of two traversing screws, which are power driven. A vertical spindle is free to rotate in large plain bearings, fitted on the inner side face of each head, and between the bearings is mounted an alloy steel forming roll. The spindles of both heads are driven, through heavy-duty universal shafts, from gear-reduction units on top of the machine frame.

The rolls have a form that is generally similar to a spur gear, but the periphery of each roll is not parallel for the whole of the tooth width. A parallel portion extends for approximately half the thickness of each roll, and the lower portion, as viewed when the roll is mounted on the machine, is tapered, to form a "lead in." Below the rolls is supported the induction heating coil, which is

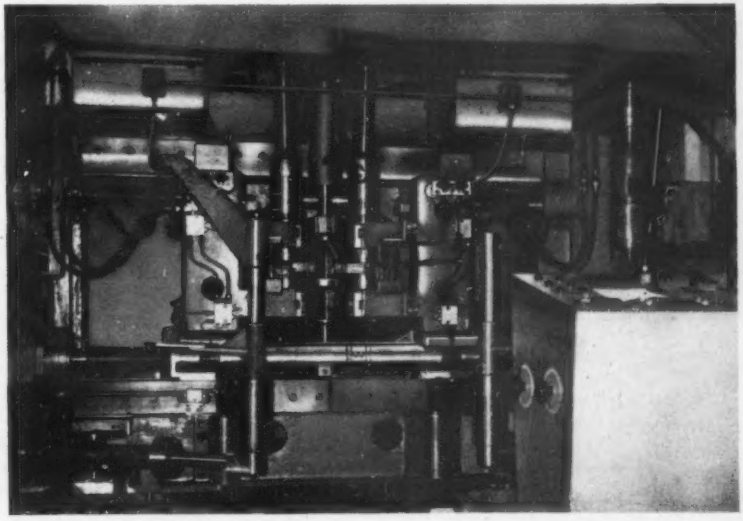


Fig. 12. An Experimental Machine for Hot Rolling the Teeth of Spur Gears. After a Blank has been Loaded, it is Fed Upwards through an Induction Heating Coil, whereby it is Raised to the Forming Temperature before it is Engaged by Two Power-driven Toothed Rolls

water cooled, and the blank to be formed is loaded on to a vertical hydraulic ram below, and co-axial with the coil. The blank is advanced upwards through the coil, whereby it is heated to the forming temperature, and enters the space between the "lead in" portions of the two rolls, which are driven at a speed determined by trials. As the upward movement of the blank continues, it is engaged by the teeth of the "lead in" portions of the rolls, then by the parallel teeth, which form teeth of the required involute shape on the periphery of the blank. All motions and adjustments, also the speed of the forming rolls, are controlled from the desk seen at the right.

As has already been intimated, the next article in this series, to be published shortly in MACHINERY, will be concerned with some of the automatic transfer lines that have been designed and built by ENIMS, or were under construction in the associated machine tool works at the time of our visit.

Instant-release Latch Mechanism

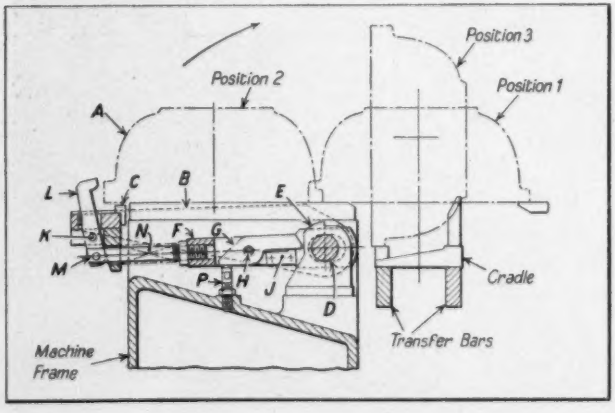
By B. R. OBRA

On an automatic machine that has recently been designed, it is necessary to tilt a bowl-shaped part through 90 deg., from a horizontal position, above the transfer bars, to a vertical position, where it rests in a cradle on the same transfer bars. First, the part is moved sideways from its position over the bars, until it is located above a hinged platform. Then, this platform is swung about its pivot to turn the part through 90 deg. before it is deposited on the cradle. The mechanism here shown has been designed for securing the part to the platform during rotation, and releasing it into the transfer cradle at the precise moment when it reaches the vertical position. After the part has been released, the swinging platform is returned.

Initially, the workpiece *A* is in Position 1 above the transfer bars and is moved sideways to Position 2 above the swinging platform *B*. The platform is arranged so that the workpiece can drop through a small angle below the horizontal plane, in order that it may pass over the button *C*. This button prevents the part from sliding down the platform as it is swung upwards. The platform is rotated by a shaft *D*, which passes through a latch-operating cam *E*, secured to the machine frame. The shaft *D* also passes through elongated holes in the clevis end of the latch-operating link assembly *F*, which straddles the cam *E*. A cam follower *G*, located between the clevis legs of the link assembly *F*, can pivot freely on the pin *H*, but its movement in a clockwise direction is limited by the stop *J*.

A pin *K*, fixed to the swinging platform, carries the latch *L*. The end of the link assembly passes through a clearance hole in the platform, and has a forked end which straddles the latch *L*, and is coupled to it by the pin *M*.

The platform is swung upwards by the link assembly, acting through the pin *M*. During this motion, the cam follower *G*, supported by the block *J*, rides up the high lobe of the cam *E*. In consequence, the spring *N* is compressed, and the latch *L* is closed on to the workpiece. Thus, the part *A* is latched securely to the platform *B*, as long as the follower *G* is in contact with the radial (dwell) portion of the cam *E*. At the precise moment when the part is in the vertical position, the cam follower reaches a vertical face at the end of the radial portion of the cam *E*, and the link assembly is free to move inwards. The spring *N* can then force open the latch *L*, so that the part is freed instantly from the platform. The part is left resting in its transfer cradle (Position 3) as the platform returns to its starting position. During the return movement, the cam follower *G* swings about the pin *H*, so that it can pass over the lobe of the cam. As the platform finally comes to rest at its starting position, the cam follower *G* is re-set by the button *P*, and the latch mechanism is ready for the next cycle.



A Mechanism which Provides for Instant Release of a Latch when a Workpiece has been Swung into a Vertical Position

Performance Tests for Balancing Machines

By W. I. SENGER*

Most machines and mechanical appliances incorporate rotating parts which must, or should, be balanced to provide for smooth and quiet operation and long service life. Since balancing is a quality control operation, equipment for this purpose should be purchased on the basis of specifications for accuracy and quality of product, just as one would purchase production gauging equipment. However, trained men are not available in most plants to assess the relative merits of competitive balancing equipment or accurately to judge the performances of various types.

With a general trend towards higher operating speeds and closer tolerances for working assemblies, it is becoming increasingly important that those involved in the specification, purchase, operation, and maintenance of balancing equipment should be well informed concerning the basic features which a balancing machine should offer, and should understand why these features are important to the success of their own operations. This article is intended to provide a guide for such individuals, and sets out simple but basic requirements for balancing equipment and the reasons for those requirements.

The term "balancing machine" can apply to motor vehicle wheel balancers, static balancers, knife edges, automatic balancers, production balancing machines, micro-balancers, and many other forms. Each type of balancing machine is designed to handle a specific class of work with a specific degree of accuracy. Basically, a balancing machine is a device for weighing the amount of material which should be added or removed from a rotating part or assembly to eliminate vibration at the supporting bearings.

The United States Navy has established two order-of-accuracy specifications for rotating components. (1) Report No. 371-V-24, Department of the Navy, Bureau of Ships, Code 371; and (2) MIL-STD-167, Department of the Navy, Bureau of Ships. Also, Section 89 of the Tool Engineer's Handbook, First Edition, covers commonly accepted practice for general classes of work. The buyer of a balancing machine, however, should establish his own requirements for accuracy of balance based on the following considerations: (1) Present requirements for satisfactory operation of the product to meet competition. (2) Future requirements for an improved product to meet or overcome competition. (3) Future requirements for greater accuracy of balance for new designs of products which may operate at higher speeds.

Performance tests should be carried out for all balancing machines with maximum capacities up to 10,000 lb. For machines with a greater maximum-weight capacity, the tests should be made on a smaller, standard type of balancing machine. In addition, the similarity of all features of the small machine and the large machine should be compared visually to assure compliance with specifications.

Equipment for the performance tests should comprise: —

(1) A small test rotor with a weight within 5 per cent of the minimum capacity as stated in the specification. The distance, in inches, between the transverse centre lines of the bearings of this test rotor should be within 10 per cent of four times the cube root of the weight in pounds. Also,

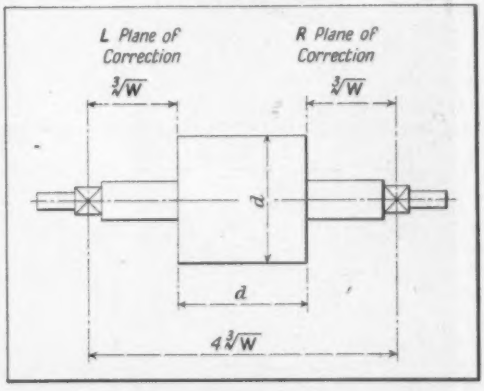


Fig. 1. Suggested Dimensions of a Test Rotor for Performance Testing a Balancing Machine. The Weight (W) Should be Within 5 per cent of the Maximum Capacity Specified. It Can be Shown that for a Steel Rotor $d = 1{\cdot}6\sqrt[3]{W}$, but for Convenience a Value of $d = 2\sqrt[3]{W}$ May be Employed

* Gisholt Machine Co., U.S.A.

the distance in inches from the transverse centre line of a bearing to the nearest plane in which unbalance may be introduced should be within 10 per cent of the cube root of the weight in pounds.

(2) A test rotor with a weight within 5 per cent of the maximum capacity as stated in the specification. All length dimensions should be as shown in Fig. 1.

(3) A test rotor having a weight within 5 per cent of one-half of the sum of the maximum and minimum weight capacities. All length dimensions should be as shown in Fig. 1.

(4) A scale capable of weighing each of the test rotors to an accuracy of 1 per cent.

(5) A scale capable of weighing (within 1 per cent accuracy) unbalance weights corresponding to 0·000025 times the minimum weight of the test rotor divided by the radius at which unbalance may be added.

(6) A shaker table to provide a platform that will simulate floor vibration. The platform capacity must be such that a complete balancing machine, set up with one of the test rotors it will be called upon to handle, may be mounted on it. The vibrations produced must be in both horizontal and vertical directions, which are at right angles to the test rotor rotational axis. Vibrations in the two directions may be produced simultaneously or independently. Vibration displacement of the platform (complete with balancing machine) in either direction must be 0·003 in. The vibration frequency range of the shaker table should be 25 to 110 per cent of the minimum balancing speed of the balancing machine under test.

(7) A dial indicator, graduated to 0·001 in., with a suitable supporting stand.

(8) A spring balance, or scales, suitable for determining the weight of the driving members.

If a commercial shaker table is not available, the balancing machine can be mounted on a platform supported by air springs, as shown in Fig. 2 . If a rigid platform is not available, it can be made in

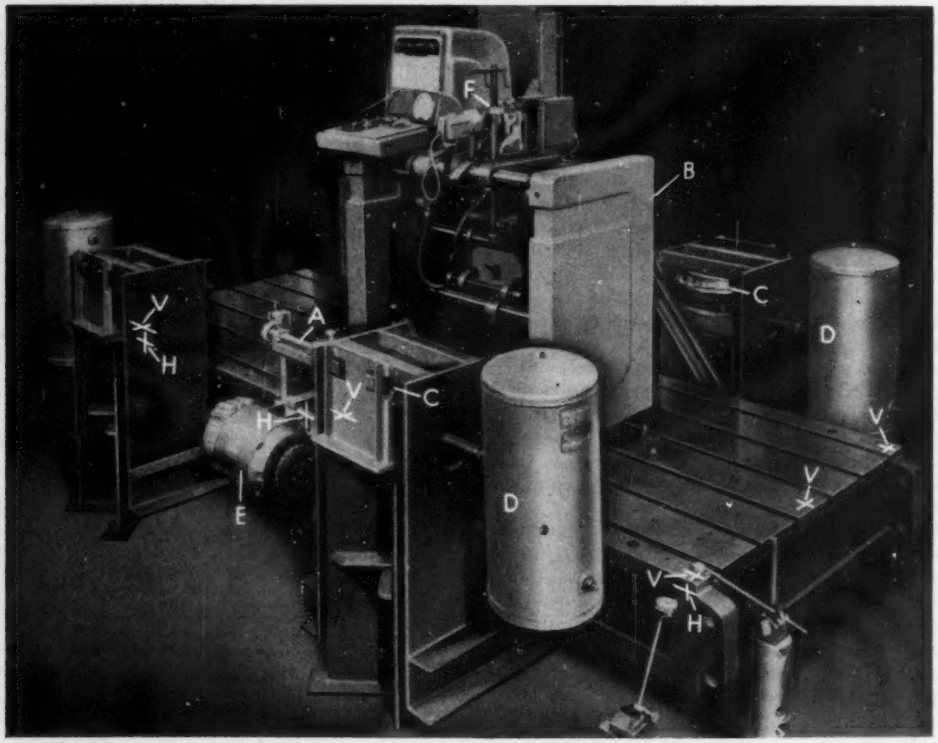


Fig. 2. Set-up for Testing a Balancing Machine. The Platform is here Mounted on Air Springs and is Vibrated by Means of Exciter Shafts

reinforced concrete, 8 in. thick, and should have a minimum width and length of 72 in. The platform and the machine mounted on it are forced to vibrate by unbalance in exciter shafts *A* and *B* (the latter is hidden in the figure). These shafts are rotated by a variable-speed motor, *E*, through a timing belt drive. For a universal platform, the shaft speed range should be from 50 to 1,500 r.p.m. with any speed in the range held within 1 per cent of the desired value.

The balancing machine should be mounted on the platform, as shown, so that the test-rotor centre line is midway between the exciter shafts. Also, the machine should be centred along the length of the platform. "Airide" springs, *C*, made by Firestone Industrial Products Co., Akron, Ohio, U.S.A., can be used satisfactorily to support the platform and machine, to give a natural frequency of about 20 oscillations per min. The air vessels for the springs are indicated at *D*.

In a test, unbalance is introduced in the shafts *A* and *B* with the two unbalances in the same angular direction. With the exciter shafts operating at the minimum balancing speed of the test rotor, the vertical vibration displacement of the platform is determined by the use of a dial indicator at points marked *V* in Fig. 2, two of which are hidden. The total vertical displacement at all points should be 0·003 in. within ±0·001 in. If the amplitude is not in this range, the unbalances in shafts *A* and *B* should be independently modified until the displacement mentioned is obtained. The horizontal vibration displacement is checked at the points *H*, one of which is hidden, and should be of similar value.

TEST FOR TWO-PLANE BALANCING MACHINES

Two-plane balancing machines should indicate directly the amount and angular location of a single correction required in each of two arbitrarily selected correction planes. A suitable arrangement should be interposed between the members which directly support the workpiece and the indicator which first responds to the presence of unbalance, so as to provide separate indications of the unbalance correction required in each of the two arbitrarily selected correction planes. These results should be obtained without the unbalance effects in one plane giving an indication of unbalance in the other plane. Four readings (the amount and angular location of unbalance in both selected planes) should be taken in one operation, with only one starting and stopping of the workpiece. Visual inspection should be made to ensure that provision is made for plane separation.

The following test may be made with the machine adjusted to any desired sensitivity. Set up a test rotor and determine that the interposed arrangement is properly adjusted. Correct for unbalance in each plane of the test rotor until the application of additional correction does not further reduce the unbalance indication. Introduce in the left-hand plane of correction an unbalance of 20 *U* (the allowable residual unbalance in oz.-in.) for which a formula will be given later in this article. The unbalance indication in the right-hand plane should be less than *U*. This test should be repeated with 20 *U* unbalance in the right-hand plane of correction and no unbalance in the left-hand plane. The unbalance indication in the left-hand plane should then be less than *U*. With the 20 *U* unbalance placed midway between the correction planes, there should be indications of unbalance in both the right- and left-hand correction planes. If the machine is arranged for balancing at varying speeds, this test should be conducted at the maximum and at the minimum specified speeds. Also, the operation should be repeated with the other test rotors.

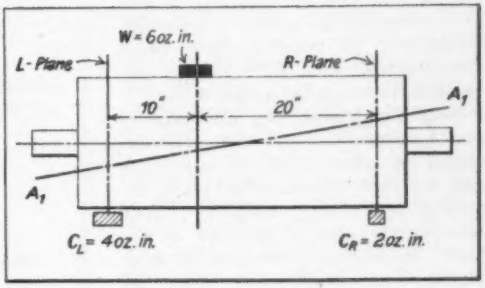


Fig. 3. An Unbalance Weight (*W*) of 6 oz.-in. can be Compensated by Placing a Weight (C_L) of 4 oz.-in. in the plane (*L*), and a Weight (C_R) of 2 oz.-in. in the Plane (*R*)

The least number of alterations of mass required to balance a rotor is two. If only the unbalance *W*, Fig. 3, is present in the part, it is obvious that one correction weight must be placed in each of the two correction planes *L* and *R*, to prevent the part from rotating about the axis $A_1 - A_1$ when not restrained in bearings. If two corrections are the least number that will give a balance, it is undesirable to make more than two, because of the time involved in preparing for and applying corrections.

Only occasionally does the configuration of the work, or the special conditions under which it will operate, make additional corrections desirable or necessary. Long, high-speed cylindrical parts

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must often be balanced at high as well as low speeds in order to eliminate deflection. In practice, each transverse section of a part will be unbalanced. It can be assumed that W in Fig. 3 represents the unbalance in one such section, and that planes L and R are those in which corrections can be most conveniently made by adding or reducing weights without affecting the desired qualities of the part. By making corrections in these planes, it is possible to neutralize the centrifugal force caused by W.

In Fig. 3, the heavy spot W happens to be nearer to the correction plane L than it is to the plane R. An unbalance W of 6 oz.-in. in the relative position shown may be compensated for by the two correction weights C_L of 4 oz.-in. and C_R of 2 oz.-in. In a similar manner, corrections could be made in the planes L and R for unbalance in other transverse sections of the part. An effect identical with the resultant of all these individual corrections can be produced by a single correction weight in each plane. With two corrections of proper size and position, one in each of two planes, the body can be corrected for both force and moment (static and dynamic) unbalance.

One desirable feature of a balancing machine is that it should indicate, directly, the amount and angular location of the correction required in each of the two planes. Selection of these planes should be determined only after consideration of the design and function of the workpiece, and where

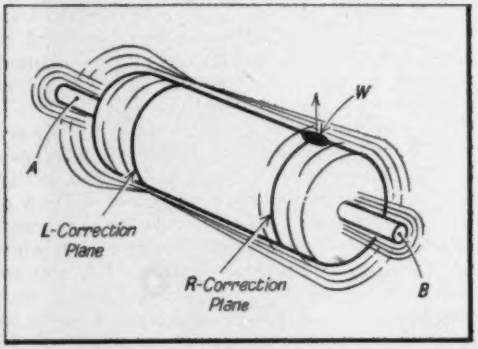


Fig. 4. Unbalance W of this Rotating Cylinder will cause Vibration at Both Bearing A and B, Although the Only Correction Required to Balance the Part Perfectly is in the Plane R

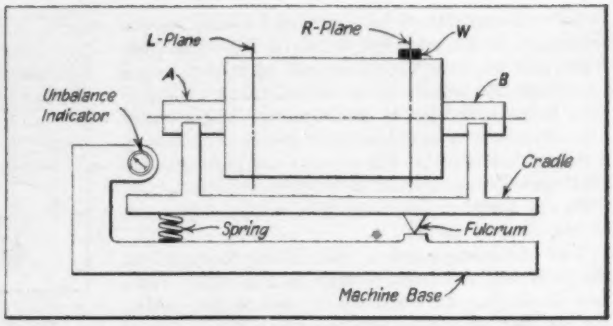


Fig. 5. One Method of Separating the Unbalance Effects in the Two Selected Correction Planes is to Support the Workpiece in a Pivoted Cradle. The Fulcrum is Placed in One Plane, while Unbalance is Measured and Located in the Other

and how corrections can be made most quickly and economically.

If the balancing machine is to give direct indications of corrections in each of the two selected corrections planes, it must have certain elements, the need for which will be understood by referring to Fig. 4. The rotating cylinder is here flexibly supported at A and B, and the planes L and R represent those selected, in which corrections can be made. The cylinder has only one unbalance W which, for the purpose of discussion, has been placed in the R correction plane. As the cylinder rotates, the unbalance W will not only cause pronounced vibration at the bearing B, but will also cause vibration at the bearing A. This vibration occurs despite the fact that the only correction required to balance the piece perfectly is in the one plane R.

If unbalance is present in both planes of correction, the motions of the bearings A and B are complex because each bearing is caused to vibrate by the unbalance in both correction planes. Unless some means of separation is interposed between the bearings and the ultimate unbalance-indicating device of the balancing machine, it is impossible to obtain direct indications of unbalance in either plane. The motion of the bearings alone cannot be used as a measure of the amount of unbalance.

There are three methods by which this separation of unbalance effects in each of two selected correction planes can be accomplished. One method, involving the use of a pivoted cradle, is shown schematically in Fig. 5. The part to be balanced is supported at A and B on a cradle arranged with a fulcrum. This fulcrum is located in one of the two selected correction planes L or R while unbalance effects in the other correction

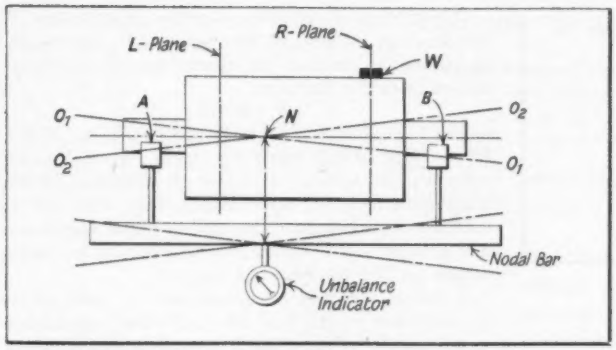


Fig. 6. For Another Method of Separating Unbalance, a Nodal Bar is Employed. The Rotating Cylinder is Flexibly Supported by Bearings *A* and *B*, which are Attached to the Nodal Bar

plane are measured. At a point remote from the fulcrum, the cradle is spring-supported. As the piece is rotated, unbalance indications for the plane which is being measured are obtained by noting the amount of motion between the cradle and the machine base at a point remote from the fulcrum. The centrifugal force of W in plane R will show a zero reading on the indicator, since the centrifugal force acts on the cradle where it is supported by the rigid fulcrum. Likewise, when the fulcrum is placed in plane L and the piece is again rotated, only the unbalance W in plane R will give a reading, and this reading will not be influenced by any unbalance which may be present in the plane L.

Another method, whereby suitable means are interposed between the bearings and the unbalance indicator, involves the use of a nodal bar. This method is shown schematically in Fig. 6, where the cylinder is flexibly supported by bearings at A and B. These bearings are attached to the nodal bar, which will have the same motion as the axis of the cylinder. It may be assumed that the cylinder is in perfect balance except for an unbalance W in plane R. As the piece is rotated, the bearing axis will vibrate between the lines O_1-O_1 and O_2-O_2, motion at the bearing B being greater than at the bearing A. At point N along the axis, and at the corresponding point on the nodal bar, there is no vibratory motion. An unbalance indicator placed at this nodal point, as it is termed, will give no reading of the unbalance W in plane R. It will, however, indicate any unbalance which may be present in the plane L. Likewise, there is another nodal point at which unbalance in the plane R will be indicated, uninfluenced by unbalance in the plane L.

The third method of plane separation, which involves electrical networks, as shown schematically in Fig. 7, provides, essentially, an electrical nodal bar. Again, the part is flexibly supported on bearings at A and B. Attached by rods to these bearings are lightweight coils located in the fields of strong permanent magnets. These coils have a motion determined by the displacement of the axis of the cylinder, and are connected through an electrical network to a meter which is the unbalance indicator. When the coils vibrate within their respective fields (because of the vibration of the bearings to which they are attached), there is generated in the coils an alternating voltage with a magnitude proportional to the amplitude of bearing displacement. The voltage divider provides a means of electrically placing the unbalance indi-

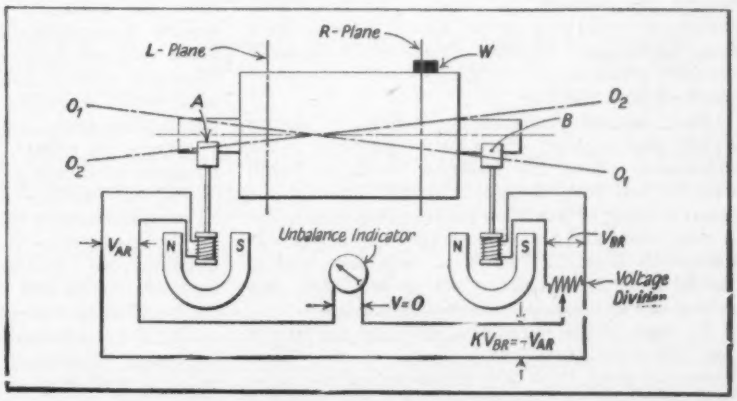


Fig. 7. With this Method of Plane Separation, Lightweight Coils (Located in the Fields of Strong Permanent Magnets) are Attached by Rods to the Workpiece Supporting Bearings *A* and *B*

TABLE 1. RESIDUAL UNBALANCE FOR ROTORS OF VARIOUS WEIGHTS

Rotor Weight, lb.	Residual Unbalance, oz.-in.
25	0·018
50	0·035
100	0·039
200	0·044
300	0·051
400	0·058
500	0·063
600	0·070

cator at the nodal point. Likewise, there is another electrical network which will indicate unbalance in plane R uninfluenced by unbalance in plane L.

ACCURATE AMOUNT INDICATION

The measuring device for amount of unbalance should have at least ½ in. displacement for measurement of an allowable residual unbalance which will cause a vibration of 0·000025 in. at the bearing surfaces of the workpiece. To meet U.S. Navy Specification MIL-STD-167, the indication device for amount should have at least ½ in. displacement for measurement of allowable residual unbalance determined by the following formulæ:

$U=4W/N$ (for parts which normally run at speeds in excess of 1,000 r.p.m.); and $U=5630W/N^2$ (for speeds between 150 and 1,000 r.p.m.), where U = allowable residual unbalance, in oz-in. W = weight of rotor, in pounds; N = maximum operating (not balancing) speed in r.p.m. for parts to be balanced on the machine. (It is not necessary that the part be rotated at this speed during the balancing operation.) To meet the requirements of a particular job, the specification should be changed to read: the amount-of-unbalance measuring device should have at least ½-in. displacement for measurement of an allowable residual unbalance of . . . oz.-in. in each correction plane of part number. . . .

The amount-of-unbalance indicating device should give readings which are proportional to the unbalance. Also, the indicator readings should vary by less than one-fourth of the value of the mean reading of the allowable residual unbalance. A rotor corrected for balance until the amount-of-unbalance indicator shows a minimum reading should have an unbalance not greater than one-fourth of the allowable residual unbalance.

To meet the requirements proposed by Report No. 371-V-24 of the Department of the Navy, Bureau of Ships, Code 371, this section of the specification should be changed to: A rotor corrected for balance until the amount-of-unbalance indicator shows a minimum reading, shall have not more than the "residual unbalance" shown in Table 1.

If accuracy is specified in terms of vibration at the bearing surface of the workpiece, the oz.-in. of allowable residual unbalance should be determined from the formula:

$$U=8Wd$$

where U = allowable residual unbalance, in oz.-in.; W = weight of the test rotor, in lb.; d = balancing accuracy, in inches, in terms of vibration at the bearing surface. If specification MIL-STD-167 is used for accuracy, the allowable residual unbalance which is permitted by the formula should be determined for the smallest test rotor.

A radius r should be established (in each plane of correction on the test rotor) at which unbalance may be added. The correction weight which, when placed at radius r, will produce the desired allowable residual unbalance U, may be found from the formula:

$$w=U/r$$

where w = necesary correction, in oz.; U = allowable residual unbalance, in oz.-in.; r = radius, in inches, at which the weight may be added.

The following tests should be made with the test rotor running at the lowest balancing speed for which the machine is supplied. Provide correction weights for each plane which will introduce 2, 5, 10, and 20 times the allowable residual unbalance. Set up the smallest test rotor (indicated at F in Fig. 2) and balance it as accurately as possible in the machine. Add unbalance of twice the allowable residual unbalance in each plane in the same radial direction. Record the unbalance-indicator reading for each plane of correction and record the inches of displacement of the unbalance indicator. The displacement of the unbalance indicator should be in excess of 2½ in. for 20 times the allowable residual unbalance reading. Record the unbalance-indicator readings for each plane with unbalance of 2, 5, 10, and 20 times the allowable residual unbalance in each plane in the same radial direction. The results should be set out in the manner indicated in Table 2.

Figures for columns (4) and (5) in Table 2 are obtained by dividing either column (2) or column (3) by the values in column (1). The values in either column (4) or (5) should not deviate from the 20 U value by more than the percentages indicated in column (6). The above test should be repeated for each size of test rotor.

The smallest test rotor should be balanced by using the procedures normally employed for measuring unbalance. Corrections are applied for balance until they are no longer effective. An unbalance equal to 5 U is then introduced at 0 deg. in the left-hand plane and the amount of unbalance-indicator reading observed. This operation is then repeated with the same unbalance

TABLE 2. FORM FOR TABULATING THE RESULTS WHEN TESTING FOR ACCURATE AMOUNT INDICATION

Column Number					
1	2	3	4	5	6
Number of *U* Units in Each Plane	Unbalance Indicator Reading		Ratio of Unbalance Indicator Reading to Number of *U* Units		Permissible Deviation of Ratio (Columns 4 and 5) from the 20 *U* Value, per cent
	Left-hand Plane	Right-hand Plane	Left-hand Plane $\left(\frac{\text{Col. 2}}{\text{Col. 1}}\right)$	Right-hand Plane $\left(\frac{\text{Col. 3}}{\text{Col. 1}}\right)$	
2					12 1/2
5					5
10					2 1/2
20					0

placed at each 30 deg. around the rotor in the left-hand plane. Next, the same operation is carried out for the right-hand plane, and, finally, the readings in Table 3 are filled in.

The maximum and minimum readings shown in the table must be 180 deg. apart, ±30 deg. To satisfy the requirements of Report No. 371-V-24, the total of the readings divided by 60 (*B* in Table 3) must be greater than the difference between the maximum and minimum values divided by 2 (*C* in Table 3).

In order to meet the requirements for a specific job, the total of the reading divided by 60 (*B*) should be greater than four times the difference between the maximum and minimum values divided by 2 (*C*).

Since the vibratory motion of an unbalanced piece is small and the measurement of such motion is the only means of determining the size or amount of the required correction, some means must be employed for amplifying this motion for the purposes of precise measurements. For example, if it is required that the run-out of a shaft be reduced to 0·001 in. total indicator reading, it is good practice to use an indicator which will read to an accuracy of 0·0001 in.

Therefore, the specification should require a minimum of ⅛in. of unbalance-indicator movement to represent the allowable residual unbalance. If the balancing machine is a production device, it is essential that minimum unbalance indication should be easily read by the operator so that he may fairly discriminate between parts which are and are not balanced within tolerance. In practice, ⅛ in. of unbalance-indicator movement is hardly enough for satisfactory discrimination.

TABLE 3. FORM USED TO RECORD READINGS OBTAINED IN BALANCING SMALLEST TEST ROTOR

Angle of Unbalance Weight, Deg.	Unbalance Indicator Reading for Left Plane, with an Unbalance of 5 *U* in the Left Plane	Maximum and Minimum Reading, Left Plane	Unbalance Indicator Reading for Right Plane, with an Unbalance 5 *U* in the Right Plane	Maximum and Minimum Reading, Right Plane
0				
30				
60				
90				
Then in Increments of 30 deg. to				
270				
300				
330				
A Total of the readings		.....		.....
B A ÷ 60		.....		.....
C $\frac{\text{Max.—Min.}}{2}$			.....	

K

The specification should also require that the unbalance indicator is calibrated in proportion to the unbalance in the workpiece for the convenience of the operator and to permit increased output. Reasonable proportionality is ensured by the performance test associated with Table 2. The percentage of permitted deviation is based on the assumption that the test rotor can be balanced on the machine to less than one-fourth of the allowable residual unbalance. Ability of the balancing machine to satisfy the accuracy-level requirement under optimum operating conditions is shown by the performance test associated with Table 3. If such results cannot be achieved under test conditions, it is unreasonable to expect that the operator can maintain the residual-unbalance level in production.

The sensitivity and proportionality test recorded in Table 2 takes into consideration the deviations that can be expected from a residual-unbalance level of one-fourth of the allowable residual unbalance. It is also assumed that the effect of the residual unbalance on the twenty-times-allowable residual-unbalance reading is negligible, and this reading is employed as the proportionality reference.

ACCURATE LOCATION OF ANGLE

The balancing machine should accurately locate, in each plane of correction, the point on the periphery at which correction for balance should be made. Unbalance location should be read on a continuous scale, and there should be no need for the operator to change scale for specific values of location. Also, the indications of unbalance location should be stable.

In testing for the accuracy of angular location of unbalance, the smallest test rotor should be balanced as accurately as possible. The same test weights are provided as were used in the accurate amount indication test. Twice the maximum allowable residual-unbalance weight is introduced in each plane of correction and in the same angular direction. The actual location of the unbalance weights is recorded, and the unbalance location indicated by the machine is noted and also recorded. Columns (4) and (5) of Table 4 are used for the record of unbalance location established by the machine. This operation is repeated using weights of 5, 10, and 20 times the allowable residual unbalance. Next, these tests are repeated with the weight in one plane, exactly 180 deg. from the weight in the other plane. The machine error in location of unbalance is then determined, and the values are recorded in columns (6) and (7). Column (6) should be the difference between columns (2) and (4), and column (7) should be the difference between columns (3) and (5). The acceptable angular error is shown in column (8).

It is extremely important that the balancing machine should indicate accurately the point on the periphery in each of the selected planes at which corrections must be applied to balance the piece. The importance of accurate angular indication will be apparent from the following example. It can be shown, that if the proper amount of correction for balance is made at 60 deg. from the theoretically correct location, the resultant unbalance error will be 100 per cent of the unbalance originally in the part and 60 deg. from the original location. A correction applied only 5 deg. from the theoretical location will leave a resultant unbalance having a magnitude of 9 per cent of the original unbalance and at 87½ deg. from the original location. Thus it is impossible to reduce the unbalance in a part to less than 10 per cent of its initial value in a single correction if the balancing machine location error exceeds 5 deg.

TABLE 4. FORM USED IN PERFORMANCE TESTING FOR ACCURACY OF ANGULAR LOCATION OF UNBALANCE

Number of U Units in Each Plane	Actual Location, deg.		Machine Location		Machine Error		Acceptable Angular Error, deg.
	Left Plane	Right Plane	Left Plane	Right Plane	Left Plane	Right Plane	
	Column Number						
1	2	3	4	5	6	7	8
2	0	0					15
5	0	0					6
10	0	0					3
20	0	0					1 1/2

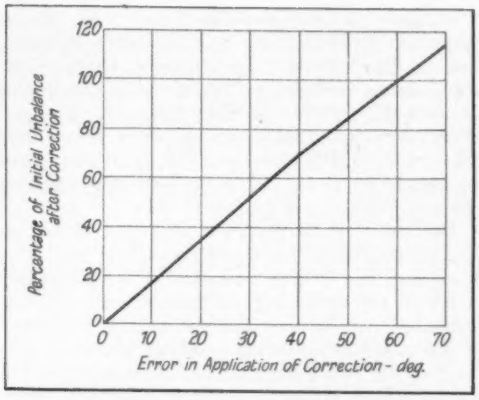


Fig. 8. Curve Showing the Percentage of Initial Unbalance Remaining After Correction has been Made for Various Angular Errors in the Application of the Unbalance Correction

The percentage of original unbalance which will be left in a part if correction is applied at a position deviating from the exact location is shown graphically in Fig. 8. The acceptable angular error established for the performance test is based on the assumption that the error should not exceed that which will permit the reduction of the unbalance to within ½ U in a single correction. If ½ U represents 5 per cent of the unbalance, the acceptable angular error is 3 deg. as indicated by the graph, Fig. 8.

EXTRANEOUS VIBRATIONS

The balancing machine should be suitable for mounting directly on a floor without the need for a special foundation or for mounting on vibration-isolation devices, even if machine tools are operating nearby on the same floor. The equivalent displacement effect on the amount-of-unbalance measuring device should not be more than 15 per cent of the amplitude of either horizontal or vertical floor vibrations, or both.

For testing the effect of extraneous vibrations, the machine should be mounted on a shaker table (similar to that previously described) capable of producing 0·003 in. displacement at the lowest balancing speed specified. The displacement must be produced in both horizontal and vertical directions which are at right angles to the rotational axis of the test rotor. Both displacements may occur simultaneously with no undesirable influence on the test, but such simultaneuous displacement is not essential.

This test should be made at the lowest specified balancing speed, using the smallest test rotor. If only one balancing speed is specified, that speed should be employed. If the balancing speed varies with the weight of the workpiece, the speed required for the test rotor should be adopted. The speed of shaker vibration should not vary by more than 1 per cent from the balancing speed.

Vibration displacement of the shaker table platform would be checked with a dial indicator. The vertical displacement should be indicated at five points on the platform—at any three corners and at the mid-points of the edges related to the selected corners. All total indicator readings should be 0·003 in. ±0·001 in. The horizontal displacement should be indicated along a platform edge at three points—at each end, and at the centre.

With the balancing machine operating at the accuracy described under the cross heading *Accurate Amount Indication*, the test rotor should be balanced as accurately as is possible in the machine. Ten times the allowable residual unbalance should then be added in each plane in the same radial direction and the unbalance-indicator readings should be observed and recorded. Without stopping the balancing machine, the shaker table platform should be started at the above displacement, and the unbalance-indicator reading noted. These readings should be substituted in the following formula, and the formula solved:

$$5555\ U/W(M_2/M_1-1) = \text{response factor}$$

Where U = the oz.-in. of allowable residual unbalance in each plane of the workpiece being considered; W = the weight of the workpiece, in pounds; M_1 = the unbalance-indicator reading noted without the shaker table operating; and M_2 = the unbalance-indicator reading noted with the shaker table operating. To satisfy the specification, the response factor should be 1·0 or less. If the shaker table provides vertical and horizontal vibration displacements separately, this test should be performed for each direction.

In all balancing machines, the workpiece is supported in a flexible structure which offers minimum restraint to the vibrator motion produced by unbalance. This supporting structure with associated amplification devices is sensitive to vibrations produced by other means as well as to those resulting from unbalance. Unless the characteristics of such flexible supporting structures are understood, so that they may be properly employed, a balancing machine may very well amplify, and measure as unbalance, vibrations transmitted through a common floor from other equipment.

The degree of vibration isolation that can be

attained practically in any mechanical or electrical system establishes the value of 15 per cent that is used in this specification. Of the vibration-isolation curves seen in Fig. 9, the solid curve is based on the ideal condition with no damping. An isolation-mounting system does not begin to be effective until the frequency of the vibration is greater than 1·4 times the natural frequency of the isolation mounting. At a vibration frequency of twice the natural frequency, 33 per cent of the vibration is passed by the isolation mounting. The curve also shows that the percentage passed becomes less as the ratio of vibration frequency to natural frequency of the isolation mounting increases. There would be some degree of damping present in a practical isolation mounting, and the characteristics would then be as indicated by the dotted curve in Fig. 9.

To apply information from these curves, it must be borne in mind that for any given balancing machine installation, no control of the frequency of the floor vibration is possible. It should also be understood that a system for isolating floor vibrations will have the characteristics shown in Fig. 9, whether the isolation is built into the balancing machine or whether the balancing machine is mounted on vibration isolators. To isolate the amount-of-unbalance measuring device by utilizing the more favourable portion of the isolation curve, only the natural frequency of the isolation mounting can be adjusted.

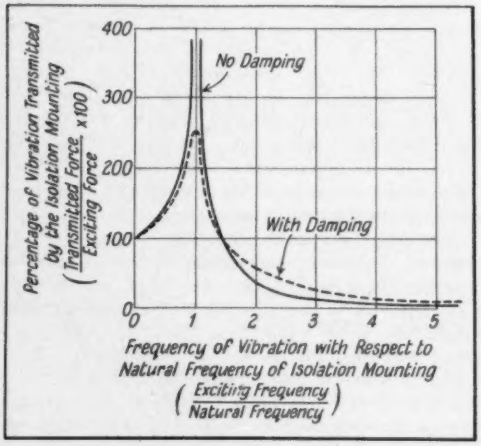


Fig. 9. Relationship of the Frequency of Vibration (with Respect to the Natural Frequency of the Isolation Mounting) to the Percentage of Vibration Transmitted by the Isolation Mounting With and Without Damping

In theory, it may be pointed out, if the natural frequency of the isolation mounting was sufficiently low, no floor vibration would pass to the amount-of-unbalance measuring device. In practice, this theoretically perfect condition cannot be attained. However, to approach this condition, it is desirable that the natural frequency of the isolation mounting should be as far below the balancing-machine operating speed as is practical.

The value of 15 per cent used in this specification establishes this relationship. If Fig. 9 is examined, and a floor vibration at the frequency at which the balancing machine operates is considered, it can be seen that the natural frequency of the isolation mounting must be less than one-third of the balancing-machine operating speed if this value is to be satisfied with no damping. With damping, it must be an even smaller ratio. The performance test does not determine the exact value of the natural frequency of the isolation mounting nor how far below the operating speed this natural frequency is. It does, however, require the natural frequency of this isolation mounting to be sufficiently far below the balancing-machine operating speed to ensure reasonable isolation from floor vibration.

A floor-vibration amplitude of 0·003 in. is used for the performance test. This is a larger value than would normally be encountered, but it can be readily determined by a dial indicator. For this value of floor vibration, the reading on the amount-of-unbalance measuring device should have changed no more than the equivalent of an unbalance that would give a workpiece vibration amplitude of 0·00045 in.

The actual value for the full amplitude of building vibration that can be expected is given by "Kempe's Engineer's Year Book for 1953" as 0·0014 to 0·00004 in. This reference further states that these vibrations take place in the three planes and are due to machinery, traffic and other causes.

The value of 15 per cent used for the practical vibration-isolation mounting specification gives the engineer who is installing a balancing machine an opportunity to determine what amplitude of floor vibrations can be tolerated for a given balancing job. To ensure that the effect on the amount-of-unbalance measuring device is no greater than one-half of the allowable residual unbalance for a balancing machine (when no more than 15 per cent of the floor vibration is passed), the maximum floor vibration permissible in the area in which the machine is installed can be found from the formula:

$F.V. = 0{\cdot}833\ U/W$

where $F.V.$ = the peak-to-peak reading in inches.

of the maximum floor vibration; U = the allowable residual unbalance (in each plane of the workpiece being considered), in ounce-inches. W = the weight of the workpiece in pounds.

From the above formula, it can be seen that where the allowable residual unbalance U is liberal for a given workpiece, larger amplitudes of floor vibration can be tolerated.

As an example, if a 10-lb. workpiece has an allowable residual unbalance of 0·002 oz.-in. (equivalent to a workpiece centre-of-gravity displacement of 0·000025 in.) the floor vibration amplitude in the area in which the machine is installed must not exceed 0·000167 in. peak-to-peak. If a different 10-lb. workpiece is required to operate under less severe conditions, so that the allowable residual unbalance is more liberal (say 0·04 oz.-in.) the floor vibrations in the area in which the machine is installed may be as large as 0·0033 in. peak-to-peak. For each of these installations, the effect of the floor vibration on the amount-of-unbalance measuring device will not exceed one-half of the allowable residual unbalance.

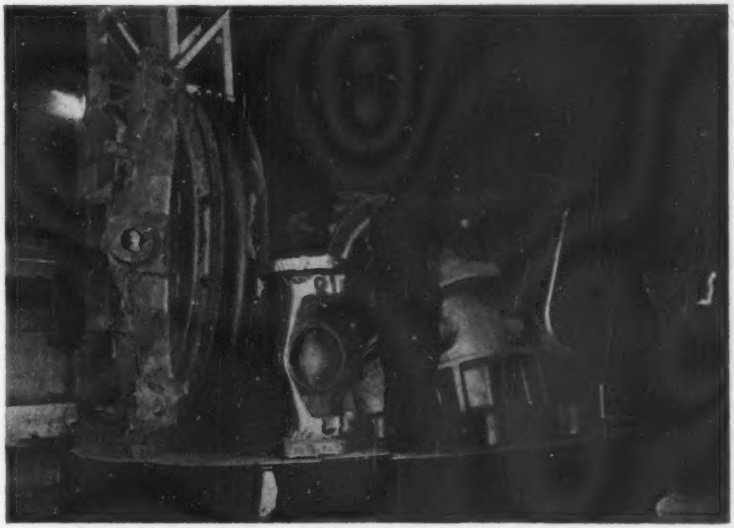
This performance test requires simulated floor vibrations to be produced in both horizontal and vertical directions, because in different types of balancing machines the work is supported flexibly in different directions. It is specified that the direction of vibration shall be at right angles to the rotational axis of the test rotor because it is in this direction that unbalance vibrations will occur.

In a second, concluding article to be published shortly in MACHINERY, other matters will be discussed, including the testing of the workpiece drive, the desirability of the balancing machine being capable of separately indicating and giving direct readings of force and moment unbalance, the need for practical correction units, and the speed of rotation of the workpiece during balancing. Among other subjects to be covered may be mentioned specifications for the driving motor, installation and service requirements, floor-to-floor and set-up times, single-plane balancing machines, and response to extraneous vibrations.

Tilghman's Large Shot Blast Plant

What is believed to be the largest mechanical shot blast room plant yet constructed, with dimensions of 30 by 25 by 16 ft., has been built by Tilghman's, Ltd., Broadheath, Manchester, and installed in the works of F. H. Lloyd & Co., Ltd., Wednesbury, Staffs. The plant is equipped with a bogie of 100 tons capacity, which has an oscillating motion during the blast-cleaning cycle. The table has a rotary motion, and cleaning is performed by five centrifugal wheel units, so positioned that in conjunction with the bogie and table movements, all pockets and crevices in castings and the entire surface areas are presented to the blast streams. A typical load of large castings is here seen on the table which is situated outside the shot blast room.

The plant has been installed to provide increased cleaning capacity to cover the output of two large foundry bays, and it permits substantial economies in cleaning time, material handling, labour, maintenance and floor space.



Castings on the Table Outside the Shot Blast Room

Developments in Fraser Unit Head Machine Tools

The firm of Douglas Fraser & Sons, Ltd., Arbroath, Scotland, are steadily extending their activities in the machine tool field, with particular reference to unit head machines for high-production applications. The company's double-ended facing and centring machines, which can be fitted with automatic loading and unloading facilities if required, are already well known, and are being used by leading firms in this country and on the Continent, as well as in Canada, Australia, and New Zealand. A variety of special-purpose machines, of both the double-ended type, based on the milling and centring machine, and of stationary and rotating work table designs, has also been supplied during recent years to firms in the motor car industry, for example, and various other machines are being built, to which further reference will be made.

The company is also concerned with automation and light-duty transfer drilling machines, and orders recently received for this type of work have included both in-line and rotary-type machines, one of which incorporates a total of seven, independent, step-feed, deep-hole drilling units.

Some 800 people are employed, and the company has an up-to-date foundry, and well-equipped machine and fitting shops for machine tool building. Recent additions to plant include a Devlieg 3B-48 Jigmil, a Swift-Summerskill planer, a Liebherr universal gear hobbing machine, a Lapointe horizontal broaching machine, and surface grinders by Lumsden and Snow. Attention may also be drawn to the comprehensive heat-treatment department and to the facilities that are available for pattern making and for welded steel fabrication and sheet metal work. A special design development department and laboratory has recently been established, for carrying out work in connection with standardized unit heads of various types.

A batch of machines nearing completion in the assembly shop is shown in Fig. 1. The machine in the foreground is a type SC2, which is being built to the order of one of the leading French motor car firms, for facing, and internally and externally chamfering at each end, the inner and outer tubes for steering column assemblies. These tubes, which are 50 in. long, and range from ⅞ to 1⅝ in. diameter, are loaded and unloaded automatically into the electrically-operated vice units, and the cycle time of the machine is 24 sec. Both spindle heads are adjustable along the bed, and only the vice jaws need to be changed for handling the different sizes of workpieces.

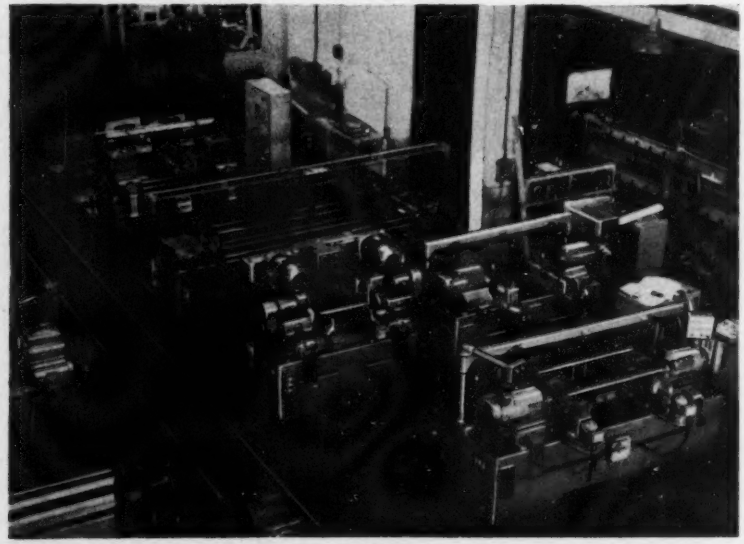


Fig. 1. Double-ended Facing and Centring Machines under Construction at the Works of Douglas Fraser Ltd., Arbroath

A machine of similar type, also fitted with automatic magazine loading equipment, is to be supplied for spot-facing and centring 16-in. long by 1⅛-in. diameter bars of 40-ton

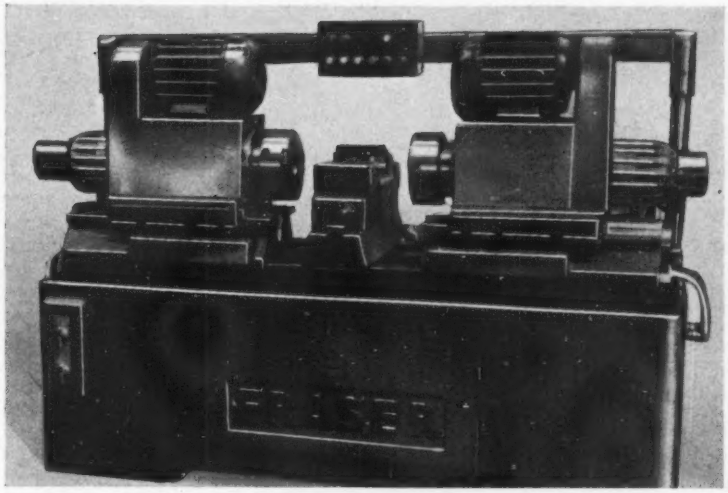


Fig. 2. Double-ended Machine with Out-feeding Cutter Heads for Machining Recesses in the Bore of a Cluster Gear

steel, and the output will be 90 pieces per hour at 80 per cent efficiency. For a British motor car manufacturer may be noted two type MC2 milling and centring machines for handling 21⅝-in. long main transmission shaft forgings. These machines incorporate automatic magazine loading equipment with chain-type input and output conveyors, and they will be linked with the hydraulic copying lathes employed for the subsequent turning operations, to provide a fully-automatic production line.

A special machine, seen nearing completion in Fig. 2, is also destined for a car manufacturer, for machining a relief recess at each end of the bore of a 6$\frac{3}{16}$-in. long cluster gear forging.

The tools are carried in recently-developed hydraulically - operated facing heads, which feed outwards to depth for producing the 1-in. long by 0·025-in. deep recesses. The spindle heads, which are driven by 5-h.p. motors, are mounted on hydraulically-operated longitudinal slides, and the out-feeding motion is engaged and disengaged by means of trip dogs and limit switches. A standard, electrically-operated torque unit is incorporated in the work-holding fixture.

Facing heads of a similar design, mounted on hydraulic-feed slide bases, are fitted to a machine which has been designed for facing and chamfering the ends of forgings for lathe headstock spindles. The left-hand head, in addition, incorporates facilities for taper boring, under the control of a flat cam and a rack and pinion drive to the facing slide, for machining the nose-end taper in the previously bored workpiece. Patents are pending in respect of this mechanism.

A drum-type loading attachment will be provided on a type SC1 machine to be supplied to

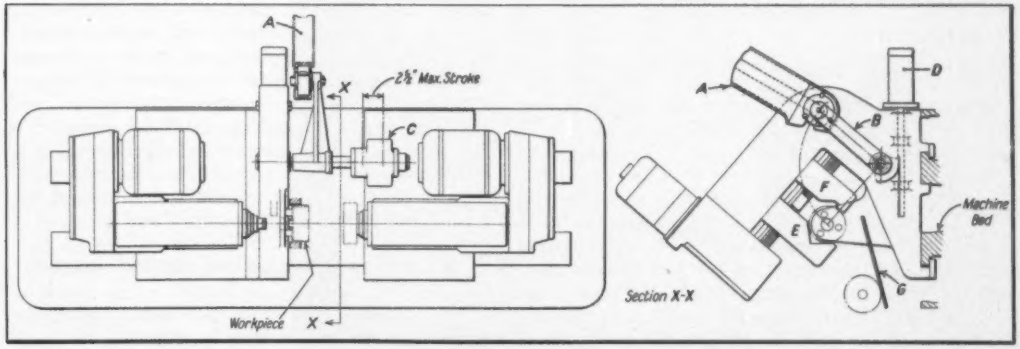


Fig. 3. Drawing Showing the Arrangement of the Machine for Facing Each End of a 4½-in. Diameter Pressed-steel End Cover

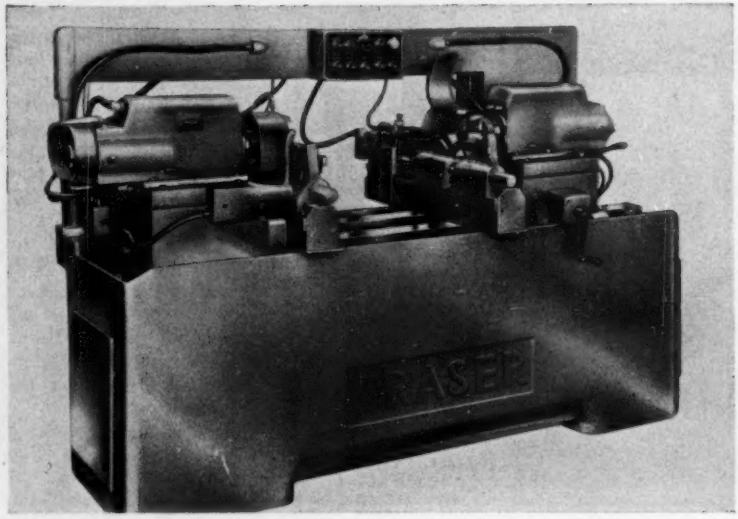


Fig. 4. The Recently-introduced Fraser Type SC2 Automatic Centring, Chamfering, and Facing Machine

another British car company for facing and centring 5¾-in. long, flanged distributor shaft forgings in a cycle time of 15 sec. On this machine, the component will be held in a vice. The drawing, Fig. 3, shows an adaptation of a type SC1 machine incorporating two No. 2 heads, and a magazine feed, which is being built for a machine tool firm for machining a ⅞-in. diameter boss face, and a 4½-in. diameter spigot face on a pressed steel end shield, in a floor-to-floor time of 20 sec., with an overall stock removal of about ⅜ in.

Referring to the drawing, the workpieces are loaded into a magazine chute *A*, and are picked up, in turn, by a pivoted arm *B*, which is fitted with spring-loaded fingers that grip the bore. The arm is moved axially, to the right, by a hydraulic cylinder *C*, and is then swung down by the hydraulic cylinder *D*, through a rack and gear segment, to bring the piece into line with the jaws *E* and *F* of an inverted vice unit. The arm then moves axially to the right, to load the piece between the jaws, up to an end stop, and after the vice has closed, the arm is moved clear in readiness for the machining operation. A standard torque unit operates the vice, and the inverted arrangement permits the finished piece to fall freely into a discharge chute *G* when the jaws open.

Shown in Fig. 4 is the recently-introduced type SC2 automatic centring, chamfering and facing machine, which largely supersedes the original SC1 type and is available in length capacities from 18 in. up to 11 ft. It can be supplied, as shown, with a fixed left-hand slide base, or with provision for adjusting both right- and left-hand slide bases along the bed. The firm's No. 2 spindle heads, which are fitted, are driven by 3-h.p. motors, and a wide range of speeds up to 1,105 r.p.m. is obtainable through pick-off gears. A reduction gearbox, to provide a low range of spindle speeds, can be incorporated if required. The spindle is designed to take draw-in collets or flange-mounted cutters, and it is carried in opposed taper roller bearings at the front, and a ball bearing at the rear.

A 2-h.p. hydraulic pump unit provides rapid traverse and steplessly-variable feeds from 1 to 50 in. per min. independently for each spindle quill, and precision stops are fitted to control the depth. The quill has a stroke of 3 in., and two feeds are available for the automatic cycle.

The self-centring, electrically-operated vices, of Fraser patented design, will accommodate workpieces from ¾ to 6¾ in. diameter without the need for changing the jaws, and they can be attached to, or separated from, the spindle head bases. It is stated that the complete change-over for length and diameter settings on the machine can be made in 3½ min. Special work holding fixtures, also automatic loading and unloading equipment, can be supplied to meet requirements.

Electrical control equipment, complete with transformers, is housed in a cabinet attached to the machine base, with the wiring carried in an overhead trunking incorporating the centralized control panel. Cutter guards and a coolant unit form part of the machine equipment.

MC2 AUTOMATIC MILLING AND CENTRING MACHINE

The Fraser type MC2 automatic milling and centring machine can also be supplied in length capacities from 18 in. to 11 ft. and it is seen in its latest form in Fig. 5, fitted with No. 2 centring

heads, change-speed milling heads, and standard electrically-operated vice units.

Each milling head is fitted with a 10-h.p. motor, which, through a timing belt and pick-off gears, provides two ranges of speeds, from 14 to 128 r.p.m. and 26 to 230 r.p.m. Drive from the pick-off gears to the taper roller bearing spindle is transmitted by worm and wormwheel. The No. 2 drill heads, carried on the milling heads, are of the same general design as those fitted on the type SC2 machine. A transverse stroke of 8¾ in. is provided for each milling head saddle, and steplessly-variable hydraulic feeds up to 15 in. per min. can be obtained. Provision is made in the control system for operating the milling and centring heads independently, if desired.

STANDARD TORQUE UNIT

The motor-driven torque unit employed for operating the vice screws on the face-milling and centring machines is of a standardized design which can be supplied separately and is being applied to a variety of other work holding fixtures on special-purpose machines. Normally, the unit is mounted on the rear face of the vice base casting, as seen at *A*, in Fig. 5, and the construction is shown in the drawing Fig. 6.

A vertical, flange-mounted, motor of ½ h.p., runs at 2,900 r.p.m. and carries a pinion *B*, which, through an idler gear *C*, drives the integral gear and worm shaft *D*. The mating worm-wheel is keyed to a spur gear *E* which drives the internally-splined output sleeve *F*, connected to the operating screw of a vice or other work-holding fixture. Plain bushes are provided for the worm-wheel and gear assembly, which rotates on a stationary shaft.

The integral gear and worm shaft also rotates in plain bearings, and it is free to move axially against a pre-load provided by a stack of Belleville washers *G*, carried on a threaded stud *H*. Provision is made for adjusting the latter, to alter the tension, in a sleeve *J* which is located axially by a ball journal thrust race. Thus, when the torque applied for tightening the vice reaches a predetermined value, the worm-wheel stops and the resulting downward axial movement of the rotating worm shaft causes a rod *K* to actuate a microswitch *L*, to stop the driving motor. The return motion of the jaws, when the vice is being opened, is arrested by contact of the rear jaw with a push rod *M*, which operates a limit switch *N*.

Fig. 7 shows an application of the torque unit for operating a vice of special design fitted to a double-ended milling and centring machine for railway axle forgings. Because of dimensional variations in the forgings, facilities are necessary for adjusting the jaws so that centring is carried out to the best advantage as regards the subsequent turning operations. Clamping is effected by downward movement of the pivoted arm *A*, which is coupled to the screw of the torque unit. Compensation for diameter variation of the workpiece is made by adjusting the seating pads *B* and *C* towards or away from each other, by means of the upper screw *D*, which has right- and left-hand threads. The slideway *E*, on which the pads are carried, is adjustable transversely along the base of the vice by the lower screw *F*.

AUTOMATIC CAM FEED DRILL UNIT

Another recent development is a cam feed drill unit, for horizontal or vertical mounting, which

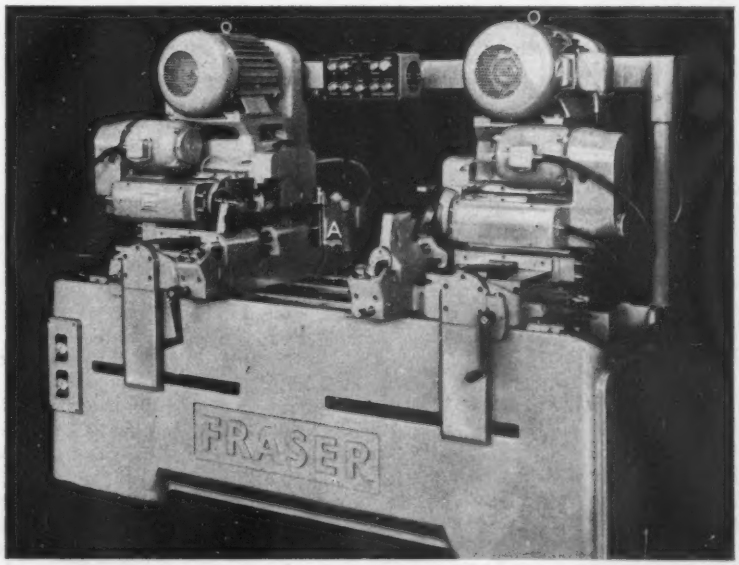


Fig. 5. Fraser Type MC2 Automatic Milling and Centring Machine

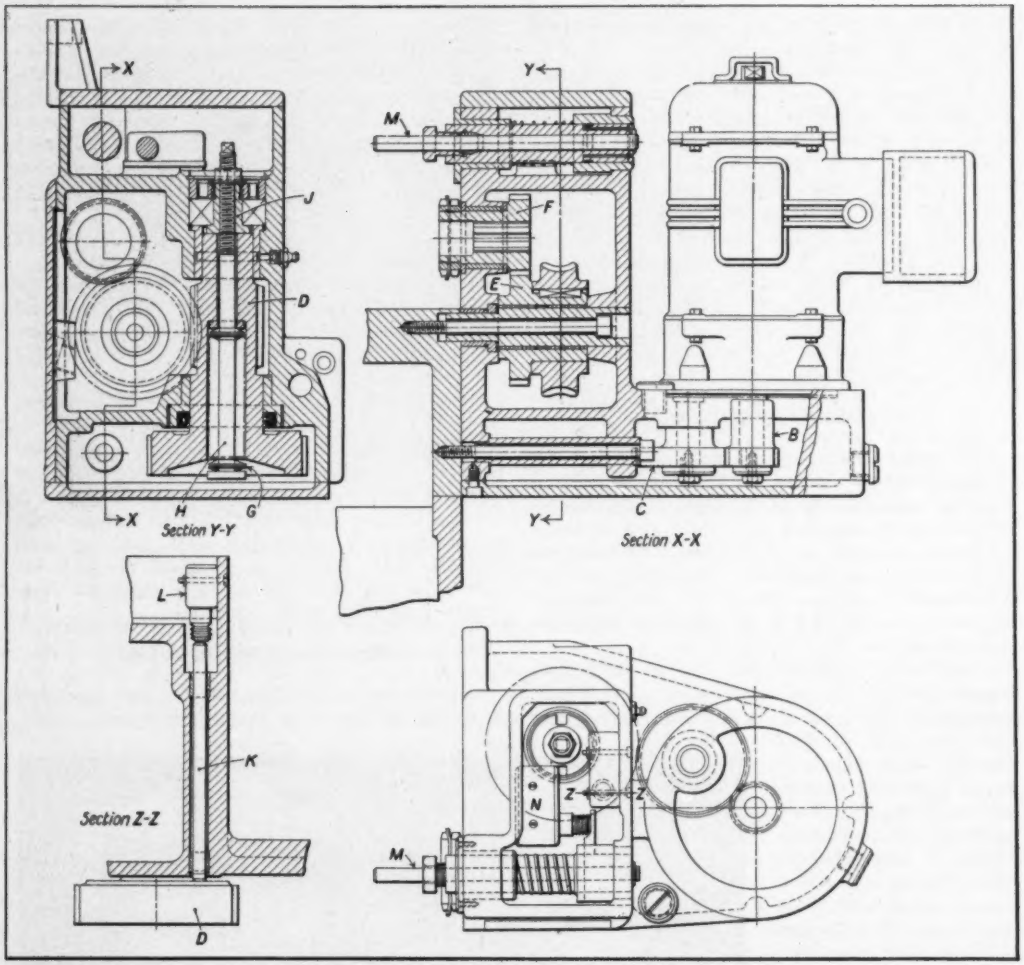


Fig. 6. Sectional and Plan Views of the Standard, Motor-driven Torque Unit

can be fitted with a driving motor up to 7½ h.p. to provide a drilling capacity, in mild steel, of 1¼ in. diameter.

The outline drawing, Fig. 8, shows two alternative arrangements of the head, that at *A* incorporating an end-mounted motor and gearbox which provides a selected spindle speed in the range 585 to 1,520 r.p.m. With the design at *B*, a timing belt drive and single-speed gearbox gives a speed in the range 435 to 2,000 r.p.m. An alternative arrangement, with the driving motor mounted in the same position, incorporates a double-train pick-off gearbox whereby spindle speeds from 75 to 1,520 r.p.m. can be obtained.

The cam provides a positive feed and return motion for the quill, and it is driven by change gears from the spindle, which give feed rates from 0·001 to 0·024 in. per rev. A quill stroke of 4 in. is provided, and the speed of rotation of the cam is increased to provide rapid traverse during the cycle at points determined by the setting of adjustable dogs, which actuate trip switches. These switches control an electro-magnetic clutch which engages step-up gears in the cam drive. A simpli-

fied arrangement, in which the cam form provides both the feed and rapid traverse motion for a particular application, can be supplied if required. The spindle is mounted in precision anti-friction bearings and has a standard nose.

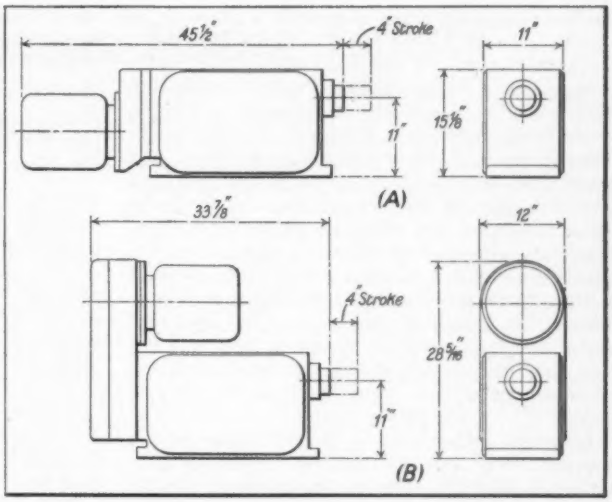


Fig. 8. Fraser Cam-feed Drilling Heads can be Supplied with Various Driving Arrangements

TYPE FMU3 MILLING HEADS

The outline drawing, Fig. 9, shows the FMU3 series milling head, which is shortly to be introduced in two basic types, with optional additional features. Type *A* has an all-gear drive, providing eight spindle speeds from 26·5 to 135 r.p.m., through four pairs of pick-off gears, and driving motors up to 20 h.p. can be fitted. In the type *B* head, final drive to the spindle is by timing belt, and four pairs of pick-off gears provide eight speeds from 190 to 970 r.p.m. Driving motors up to 34 h.p. may be used, and slower speed versions of both heads can be obtained by fitting motors running at 950 r.p.m. instead of 1,450 r.p.m.

Common to both types, the head casting has machined outer surfaces which enable it to be mounted in various positions, on a slide base if required, and both foot and flange-mounted driving motors can be employed, according to convenience, as shown on the drawing. The spindle, which runs in roller bearings, is provided with a $5\frac{1}{16}$-in. diameter standard nose.

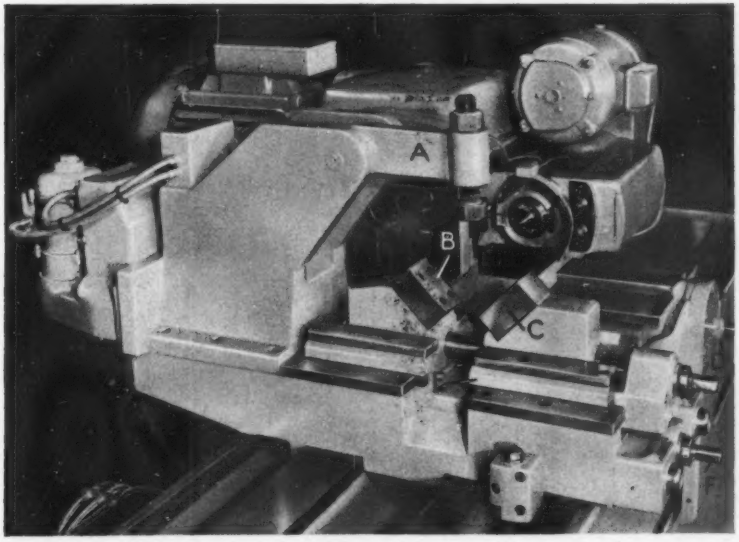


Fig. 7. Special Vice for Axle Forgings which Incorporates a Motor-driven Torque Unit

The design of the head is such that a combined gear and belt drive can be provided which enables a range of 16 speeds, from 26·5 to 970 r.p.m., to be obtained by the use of four pairs of pick-off gears, the change from gear to belt drive being made by a convenient hand control. Another feature is that both the gear and the belt driven heads can be supplied with lever - operated change gears, instead of pick-off gears, which provide four, or, in the case of the combined gear and belt drive head, eight speeds, in a range to meet requirements. Moreover, two pairs of pick-off gears can be incorporated with

the lever-operated gears to provide a range of 16 speeds.

Another version of the head is available which incorporates a 7½-in. diameter spindle quill with 6 in. of axial hand adjustment, by means of a screw, for setting purposes. Steplessly-variable power feeds to the quill from ¼ to 20 in. per min., and rapid traverse at the rate of 30 in. per min. can also be provided by a self-contained hydraulic pump and motor unit which drives the quill screw. With this arrangement, the rear position of the quill is controlled by a dead stop, and the forward position by a micro-switch operating a hydraulic valve. The length of traverse and the feed rate can readily be selected by means of dials, and the quill can be set to operate on an automatic, electrically-controlled, feed and rapid traverse cycle.

Automatic cutter relief is another feature which can be incorporated if desired, an axial quill movement of 0·1 in. being effected hydraulically. The relief motion can be applied automatically at any point in the quill traverse, and it will not operate unless the spindle is running. Dead stops ensure accurate positioning of the quill, and a push-button control is provided which enables the relief motion to be operated during setting-up operations on workpieces.

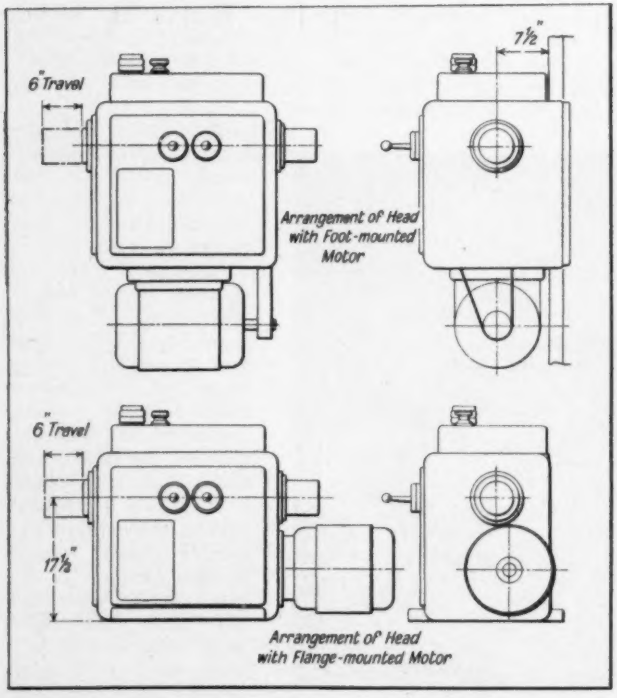


Fig. 9. Fraser Type FUM3 Milling Heads Arranged for Foot- and Flange-mounted Motor Drive

SLIDE BASE WITH SCREW-OPERATED ELECTRO-MECHANICAL FEED

In addition to hydraulic-feed slide bases for standard spindle heads, the company has designed a motor-driven, screw-operated unit which provides strokes up to 4 ft. Various rates of feed are obtained through pick-off gears, and a separate motor, in conjunction with a brushless electro-magnetic friction clutch, provides the rapid traverse motion. The automatic feed and rapid traverse cycle is controlled by adjustable trip dogs on the side of the base.

Development work is in progress on a unit head incorporating two co-axial spindles, with independent feed and rapid traverse control, for carrying out combined milling and drilling operations, for example.

Fraser double-ended facing and centring machines are sold by Sidney G. Jones, Ltd., 8 Balham Hill, London, S.W.12.

PROTECTION OF TITANIUM SURFACES DURING HEAT TREATMENT. It is reported that two research engineers of the Boeing Airplane Co., U.S.A.—Mr. N. Breslich and Mr. M. Sterry—have achieved good results with a new coating material for protecting the surfaces of titanium parts during heat treatment. An aluminium-silicone paint was first tried, but this proved to be unsatisfactory for a variety of reasons.

The mixture now employed for this purpose comprises a suitable water-soluble glass, a binding agent, a suspending agent and a vehicle. Glass, in powder form, is added to the binding agent, and a suspension in the liquid is then obtained. Two or three coats are applied to the surfaces of the titanium sheet parts which are then transferred to the furnace.

After the workpieces have been heat treated and quenched, the coating is removed in a caustic soda solution. It is stated that this coating affords effective protection against contamination by gases in the furnace atmosphere.

Argo-Vac Vacuum Melting Furnace

To facilitate the production of precision castings of improved and consistent quality, Clino Foundry Supplies, Ltd., 25 Clyde Vale, Forest Hill, London, S.E.23, have recently introduced the Argo-Vac indirect-arc vacuum melting furnace shown in Fig. 1. This company, it may be noted, is associated with Shaw Processes, Ltd., 41 Carliol Street, Newcastle upon Tyne, 1, and Close Tolerance Castings, Ltd. Shaw Processes, Ltd., are the licensers in Great Britain for the Shaw and Investment-X processes, and Clino Foundry Supplies, Ltd., provide equipment and materials for these and the shell moulding processes. Close Tolerance Castings, Ltd., Rutherford Way, Gatwick Road, Crawley, Sussex, operate the Shaw and Investment-X processes commercially, and demonstrate and develop them for the benefit of licensees. A demonstration of the Argo-Vac furnace, to mark its introduction, was staged recently at the foundry of the latter company.

With a capacity of 10 to 20 lb., the Argo-Vac furnace was developed primarily to fulfil a need for equipment of this type among licensees of the above-mentioned processes. It is, however, equally suitable for use in connection with the various other investment casting processes, and for the pouring of ingot moulds. Vacuum melting, it is pointed out, opens new fields for a number of materials, including the Nimonics, cobalt, and certain titanium alloys, also very high duty steels which are difficult to cast in air.

The furnace is generally similar, in basic design, to the simple trunnion-mounted carbon-arc pot type commonly employed in investment foundries. In this instance, however, the body, electrodes and holders are enclosed in air-tight housings, and a water cooling system is provided. Also, when the furnace is operated under vacuum conditions, the upper portion of the body is enclosed by a bell-shaped chamber, which is of an adequate size to accommodate moulds with a maximum face-area of 10 in. by 12 in. This chamber is sealed to a flange on the top of the furnace body, by means of a rubber gasket, and is secured by quick-release cam-type clamps.

The inner lining, in the form of a hollow sphere, is enclosed in an insulation of bulk refractory that fits the interior of the housing, and can readily be replaced. Carbon electrodes, of ¾-in. diameter, project horizontally into the centre of the spherical melting space, through holes in the insulation and lining, and are mounted coaxially within the roller-type trunnions. The surface of a molten 20-lb. charge lies approximately ¾ in. below them. In the top of the body, there are two additional holes, one of which is in the centre, and serves for pouring. The second hole, for charging and sighting, is situated towards the front, and is inclined to enable the charge to be observed through the sleeve A, Fig. 1, when the chamber is in the position shown. The sleeve is fitted with clear and filter-glass windows, and the latter can be removed when it is required to check the temperature of the charge with the aid of an optical pyrometer.

MOULD CLAMPING

In the close-up view, Fig. 2, may be seen details of the trunnions and electrode housings, and the arrangements for mould-clamping. Moulds of various lengths are accommodated by the use of grooved sleeves, which are adjustable vertically on two support-pillars for the clamp assembly. The latter has a slotted lug at each end, which is engaged with the particular groove that gives the required height setting. A pressure-limiting device

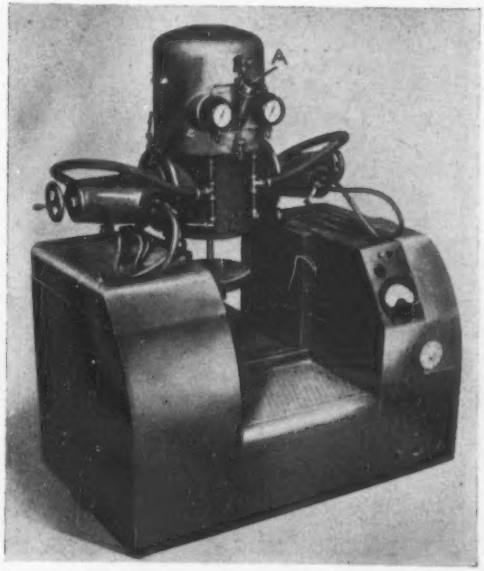


Fig. 1. The Argo-Vac Melting Furnace, Here Shown, has a Capacity of 10 to 20 lb.

is incorporated as a safeguard against mould breakage. The pad *B* is loaded by a pair of springs, which are initially compressed by tightening the handwheel nut *C*, on the screw *D*. This screw is attached directly to the pad. Pre-compression of the springs in this manner is effected before the mould is inserted beneath the clamp. Once the mould is in position, it is clamped with any desired pressure, up to the maximum that the springs can exert, by slackening the nut *C*. The underside of the nut bears against a hemispherical seating on the support-beam, and the pad *B* is thus free to align itself with the upper end of the mould.

The furnace is completely self-contained as regards ancillary equipment, which is housed in cabinets on either side, formed by the enclosure of the trunnion supports and associated structure. The left-hand cabinet accommodates the transformer, which is of the "droop characteristic" type, and was designed and supplied specifically for this duty by Hurst Electronics, Ltd. This unit is of the following rating. Input, 200/215/230/400/460 volts, single-phase, 50/60 cycles; kVA on load, 18·5; output, open circuit, 86 volts; output on normal load in air, 56 volts; output current in air, 215 amp.; and output current in vacuum, 260 amp.

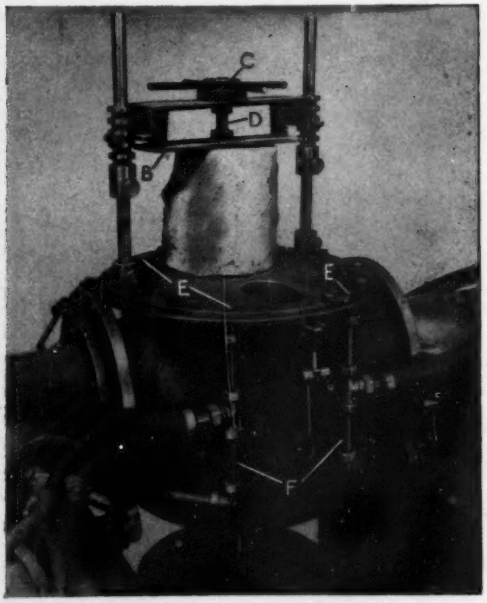


Fig. 2. Close-up View of the Body, with Chamber Removed, Showing Details of the Mould-clamp, Trunnions, Electrode Housings, and Vacuum Lines

The heat input to the furnace is controlled by adjusting the length of the arc, while referring to an ammeter mounted on the right-hand cabinet. Normally, the working gap is approximately 3 in. Adjustment is effected by means of a handwheel at the outer end of each electrode housing, which operates the electrode holder through a feed-screw. Each electrode holder is mounted on a pair of tubular guides, and the outer end of the feed-shaft passes through a rubber seal. The electrode holders are of chromium copper, to ensure good electrical and heat conductivity combined with resistance to wear.

Access to the electrode holders, for changing the carbons, is gained by removing a large screwed plug in the outer end of each housing, and the carbon is released by turning a hexagonal key.

COOLING AND VACUUM SYSTEMS

To minimize the flow of heat from the furnace body to the electrodes, trunnions, and housings, an annular water-cooling passage is provided at the inner end of each housing. The annulus communicates with a longitudinal passage in the housing, which serves for the removal of heat produced in the latter, by radiation from the melting zone. The electrode holders are indirectly cooled by heat-transfer to the tubular guides, which also form part of the water-cooling circuit. A minimum of 2 gal. per min. flow of water through the circuit is necessary for adequate cooling, and a flow-switch is incorporated which ensures that the vacuum system cannot be used unless this requirement is met. This switch controls the electrical supply to the vacuum pump and a warning lamp. Should the flow be less than the minimum indicated, the vacuum-pump is automatically isolated, and the lamp is extinguished.

The Kinney vacuum-pump, which is housed in the left-hand cabinet, is driven by a 2-h.p. electric motor, and has a capacity of 27 cu. ft. per min. A 400-440-volt 3-phase motor is normally provided, but motors of other ratings can be supplied, if required. Protected by a large-volume filter with readily replaceable elements, the pump is capable of exhausting the furnace to the normal working vacuum of 1 mm. to 3 mm. of mercury, within approximately 1½ min. Two vacuum gauges are provided, which are mounted on the chamber, on either side of the sighting sleeve. The gauge at the right covers a range from zero to 760 mm. Hg., and the gauge at the left, from zero to 40 mm. Hg., so that accurate readings can be obtained over the entire working range.

Air is exhausted from the interior of the furnace and the chamber through the vents *E*, Fig. 2, and

the associated system of pipes *F*. Additional venting is provided internally, for the extraction of air from the insulating refractory and lining. This particular arrangement of the vents, and the method of applying the vacuum, it is stated, are such that carbon pick-up from the electrodes and arc is negligible. When starting-up from cold, approximately 75 min. is required for the furnace to reach a temperature of 1,580 deg. C. Once the furnace is hot, the melting rate in air is 0·7 lb. per min., and in vacuum, 0·8 lb. per min. The superheating rate in air is 0·5 min. per lb., per 100 deg. C., and in vacuum, 0·4 min. per lb., per 100 deg. C.

An outline of typical procedure for vacuum melting, and an indication of the short cycle-time obtainable, is afforded by the following schedule for a representative 10-lb. charge, in which the individual times for the various stages are also given. Charge furnace, secure mould, and close chamber, 1 min.; evacuate, down to 1 to 2 mm. Hg., 1½ min.; melt, 13 min.; superheat, 4 min.; check temperature, with arc off, and reheat, approximately 4 min.; pour and allow to cool, approximately 6 min.; release vacuum and remove mould, 1 min.; reheat in readiness for next charge, 2 min. Total cycle-time, 32½ min. Inversion of the furnace for pouring (Fig. 3), it may be noted, is effected towards the rear, by means of a handle situated beneath the adjustable counterweight, below the body. If required, the chamber and mould can be removed while the furnace is still inverted, so that it is unnecessary to wait until the casting has solidified.

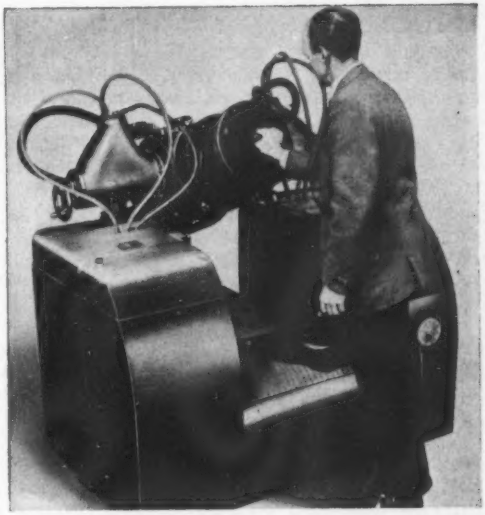


Fig. 3. A View Showing how the Furnace is Inverted by Means of a Handle Attached to the Underside of the Counterweight

OTHER APPLICATIONS

In addition to vacuum melting, the furnace can be employed for other purposes, of which the following are the most important. As an inert-gas furnace, for example, with argon; as a de-gassing and vacuum pouring furnace; and as a de-gassing unit. The procedure for operation as an inert-gas furnace is generally similar to that for vacuum melting and pouring, outlined above, except that, once the working vacuum has been obtained, and before melting is begun, the inert gas is admitted. When the furnace has been purged with the inert gas for a short period, the main vacuum control valve is closed, and the pressure is allowed to build-up to 2 lb. per sq. in. It is then maintained at this level until the charge has been melted, and is ready for pouring. After pouring, the inert gas control valve is closed, and the vacuum release valve is opened, to allow the pressure to return to atmospheric, before the mould and chamber are removed. A safety valve is provided, which is set to operate at a pressure of 4 lb. per sq. in.

When the furnace is employed for vacuum de-gassing and pouring, it may, if required, be charged with already-molten metal, from a larger furnace. De-gassing is carried out by maintaining the vacuum for a suitable period before pouring, which may be either directly into a mould, by inversion, as already described, or, after release of the vacuum and removal of the chamber, into a transfer ladle, and thence to the mould. This latter procedure is followed when the furnace is employed as a de-gassing unit.

The various controls are conveniently grouped on the front of the right-hand cabinet, and in addition to the ammeter and warning lamp, include the following. Push-buttons for starting and stopping the vacuum-pump; a handwheel for controlling the degree of vacuum; and two smaller handwheels for releasing the vacuum, and adjusting the input of inert gas. Suitable couplings are provided for connecting the inert gas supply—usually a cylinder—which should incorporate a reducing valve.

Although extensive research and development work has already been carried out, experience with the furnace has, so far, necessarily been limited. It has been established, however, that its use can result in appreciable improvements in the mechanical properties of a wide range of cast alloys, including reduced porosity. Ultimate tensile

strength and elongation are increased, and there is a marked improvement in Izod values. It is envisaged that one application for which these improvements are likely to offer advantages, is the production of cast dies. It has been found that, when casting in vacuum, the metal temperatures may be reduced slightly, and, when it is desirable to use a pre-heated mould, the heat loss is relatively small during the melting period. These effects are due to the insulating action of the vacuum. Since radiant heat from the arc is concentrated chiefly on the runner system, the temperature gradient of the mould gives improved metal feeding characteristics.

Magnetic Electrode-clamping Head for Eleroda Spark Erosion Machine

The spindle of the latest Eleroda DI spark erosion machine, made by Ateliers Charmilles, S.A., Geneva, Switzerland, is provided with a magnetic clamping head for mounting electrode holders. The machine is shown in Fig. 1, and a close-up view of the new head is given in Fig. 2.

The head is provided with two vertical stop plates at right angles, which are engaged by a flat surface and the periphery of the flanged end of the holder, for accurately locating the electrode in relation to the spindle. With this arrangement, different pre-set electrodes may be quickly attached to the head, and can then be brought into use without the need for further adjustment. Clamping and release of the electrode holder is effected by push-buttons on the main control panel at the side of the column, and the arrangement is such that it is retained on the head in the event of failure of the power supply. Provision is made for tilting the head, by means of jack screws, for setting the electrode accurately vertical.

Eleroda spark erosion machines are handled in this country by Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2.

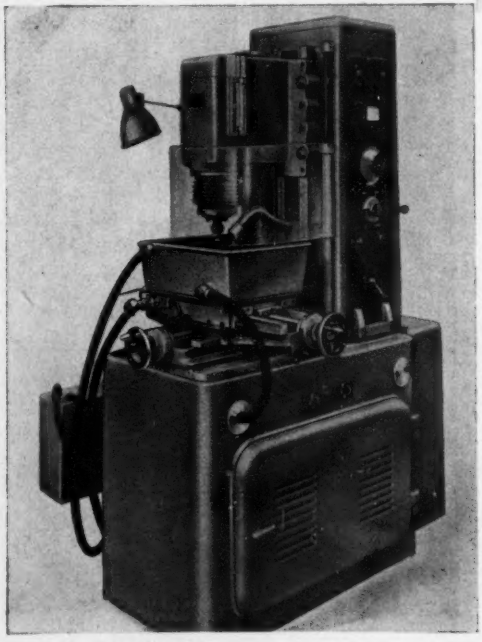


Fig. 1. Eleroda DI Spark Erosion Machine

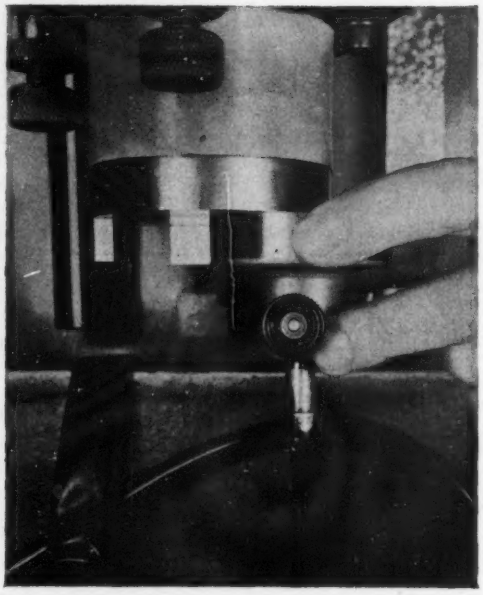


Fig. 2. Close-up View of the Magnetic Electrode-clamping Head on the Eleroda Spark Erosion Machine

COMMERCIAL MOTOR VEHICLES, with carrying capacities greater than 6 tons, produced for export during the second quarter of this year totalled 2,723. For comparison, the figures for the same periods of 1957 and 1956 were 2,298 and 3,247, respectively. It should be noted that these figures exclude the production of battery-powered electric road vehicles, and that the last month of each quarter is a 5-week period.

New Follsain-Wycliffe Fettling Shop

The fettling shop of Follsain-Wycliffe Foundries, Ltd., Lutterworth, near Rugby, was formerly housed within the main foundry block, but as more space was required on the moulding floor, a separate building has been erected which caters for the finish fettling and cleaning of castings, also for despatch. With this arrangement, the amount of manual handling of the castings has been reduced. Accommodation is provided for despatch records and the associated clerical staff. The new building is of steel frame construction, measuring 30 ft. wide by 225 ft. long, with a north-light roof.

Approximately one half of the total length of the shop is devoted to fettling and associated operations, and the equipment installed includes two Centriblast machines (Spencer & Halstead, Ltd., Wakefield Road, Ossett), for cleaning the castings after annealing, a number of double-ended high speed grinders, one single-ended high speed grinder, and two small bench-type double-ended grinders which are housed in a cabinet with provision for dust exhaustion. In addition, there are several Hicycle (Consolidated Pneumatic Tool Co., Ltd., 232 Dawes Road, London, S.W.6) hand grinders fitted with Dustraction equipment (Holman Bros., Ltd., Camborne, Cornwall).

Considerable attention has been paid to the problem of dust extraction, and the entire exhausting installation, which complies with the latest Iron and Steel Foundries Regulations, was undertaken by Dallow, Lambert & Co., Ltd., Thurmaston, Leicester. On all grinding machines, the dust is extracted both above and below the wheel, and Fig. 1 shows a typical double-ended grinder, the two exhaust ducts for the left-hand wheel being clearly visible. Dust collection above the wheel is provided by the B.C.I.R.A. Dustguard system, the suction at the guard being 5½ in. w.g.

The exhausting system has a capacity of 16,000 cu. ft. per min., and operates in conjunction with a dry tube collector, situated outside the building. This collector, which is shown in Fig. 2, is fitted with manually-operated shaker gear. Each hopper is emptied twice in a working day. The air of the entire building is changed seven times each hour, and the air in the fettling section, 14 times each hour. Individual hoods fitted to each grinding wheel are capable of extracting air at the rate of 900 cu. ft. per min., and in view of the chilling effect of this quantity of air passing the operator, combined with the regular overall change of atmosphere, special provision has been made for heating the building to a comfortable working temperature.

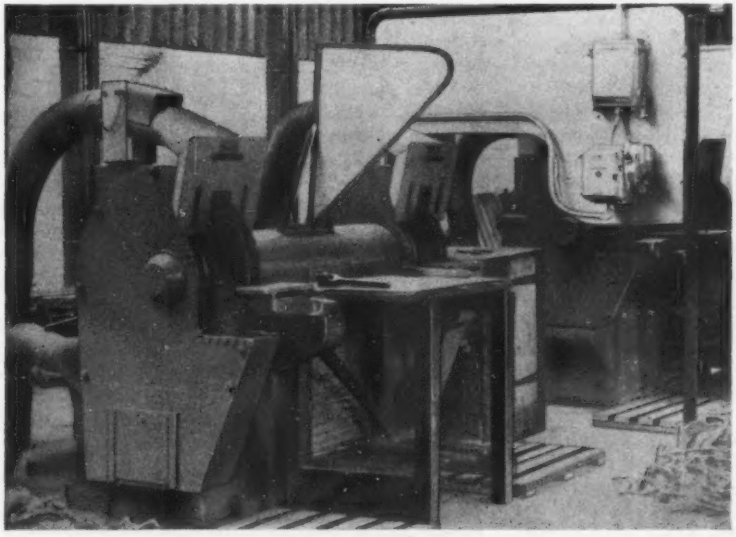


Fig. 1. Double-ended Grinder in the New Fettling Shop of Follsain-Wycliffe, Ltd., at Lutterworth. Two Dust Collecting Ducts are Provided at Each End, One Above and One Below Each Grinding Wheel

To this end, a Plenum [Air Plants (Leicester), Ltd., Aylestone Park, Leicester] air heating system has been installed, which is capable of supplying a volume of heated air equivalent to that which is being extracted. The air is heated by a thermostatically-controlled stoker heat exchanger, and is introduced into the building at the tie-bar level of

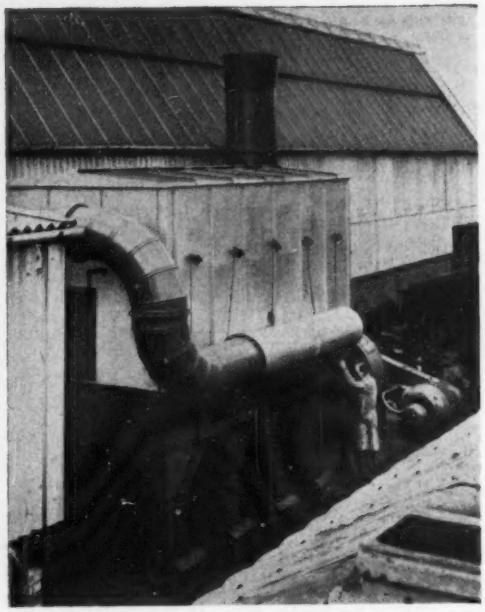


Fig. 2. Contaminated Air is Delivered to this Dry Tube Collector which is Situated Outside the Building

the roof trusses. During non-working hours, the system can be short-circuited, in order to save fuel, but when work is in progress no shop air is re-circulated, and the risk of dust-contaminated air being introduced into the building is thus avoided.

To safeguard the operators from sparks and grit, plain screen-type guards are provided between adjacent machines, and on the double-ended grinders an additional plastics guard is fitted between the two wheels, as may be seen in Fig. 1.

After fettling, and other dressing operations such as chipping and filing have been carried out, the castings are passed to the inspection area. Depending on their size and weight, they are transported either in stillages, by electrically-operated trucks, or in pans on a gravity roller-conveyor. Similar arrangements are provided for moving the work from the inspection department to the dispatch section, a weighing operation being carried out *en route*.

The floor of the building is at the same level throughout, but advantage was taken of a natural fall in the land to provide two loading bays, which are so arranged that the lorry decks are in line with the shop floor.

Ferro-Tic Steel-bonded Carbide

Attention has already been drawn in MACHINERY, 90/967—3/5/57, to the development of cemented carbide materials for which steel is employed as the binding agent. Such materials are claimed to offer important advantages in that, whilst they exhibit the desirable properties associated with the conventional cemented carbides, they can also be heat-treated, and, in the annealed condition, can be machined by most of the accepted methods. By varying the proportion of carbide to steel binder, the wear-resisting properties of the material can be increased at the expense of the machinability, and *vice versa*.

This steel bonded carbide material is now being produced commercially in the U.S.A., under the name Ferro-Tic, by the Sintercast Corporation of America, 134 Woodworth Avenue, Yonkers 2, New York. In the annealed condition, the hardness is approximately 38 to 40 Rockwell C, and the material can then be milled, sawn, drilled, and tapped, for example, and has been employed for making metal cutting tools, dies (for blanking, piercing, forging, rolling, compacting, drawing, cold-heading, spinning, and crimping), and a variety of wear resisting parts.

After machining, the material can be heat-treated by oil quenching from 1,750 deg. F., and it is stated that, in general, the recognized practices employed for hardening tool steels are applicable. In the heat-treated condition, hardness readings of 68 to 71 Rockwell C are obtained. This material is available in the form of bars up to 3 in. diameter, and rectangular sections up to 6 in. long.

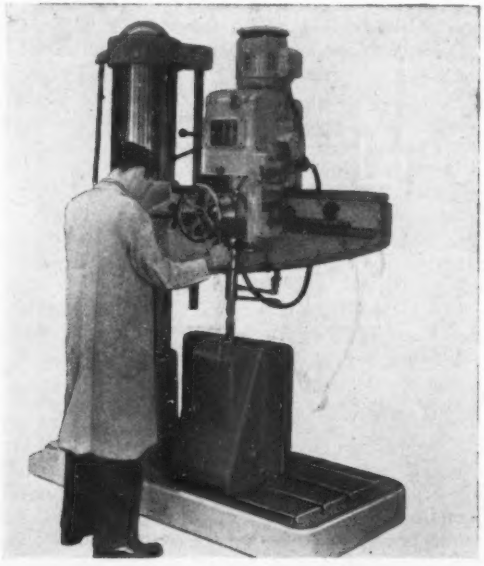
It is stated that tools made from this material for a diversity of applications have given exceptionally long life. For example, a coiling and cut-off arbor employed on a machine for winding valve springs for motor cars gives an average production of 750,000. The arbor, which is approximately 1 in. diameter by 2 in. long, is butt welded to a steel shank. In another instance, a progressive press tool, for blanking 0·008-in. thick, cadmium plated beryllium copper, is said to produce 13 times as many parts before re-grinding is necessary as were obtained with a punch and die of tool steel. For this tool, intricate inserted sections of Ferro-Tic were machined from solid blanks and completely processed by the user in his own tool room.

New Production Equipment

Kerry 1½-in. Radial Drilling Machine

The 1½-in. capacity radial drilling machine shown in the figure has recently been introduced by Qualters & Smith Bros., Ltd., Crookes Street, Barnsley, a member company of the Kerry Group, It is available in two sizes, designated types E.3 and E.4, on which the maximum centre distances between the column and the drilling spindle are 46 and 58 in.

Bored to take a No. 4 Morse taper shank, the spindle is driven by a 3-h.p. reversing motor, flange mounted on top of the gearbox. Nine spindle speeds from 90 to 1,120 r.p.m. are normally obtainable, but other ranges, from 60 to 750 or 120 to 1,500 r.p.m., can be provided if required. There are three power feeds of 0·004, 0·008 and 0·016 in. per rev., and an adjustable spindle stop is fitted to facilitate drilling holes to predetermined depths. Of nickel chrome steel, the gears are automatically lubricated by a built-in pump, and the shafts on which they are mounted run in ball bearings. The saddle is carried on needle bearing rollers on the arm ways for ease of movement, and is clamped by means of a hand lever.



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Power adjustment of the well-ribbed box-section arm on the column is provided by a 1½-h.p. motor, through a combined worm-wheel and nut which engages with a non-rotating screw. The worm-wheel and nut is mounted in anti-friction bearings and runs in an oil bath. For controlling the elevating motor, there is a conveniently-placed lever, which, when released, is automatically returned to the central position, and causes a clamp to be brought into operation for securing the arm to the column. A safety nut is fitted, and at the upper end of the screw there is a safety clutch whereby the vertical movement is interrupted in the event of the travel of the arm in either direction being obstructed.

The column sleeve swivels on roller bearings, and is secured by a lever-operated clamp. Equipment available includes box- and tilting-type work tables and a coolant pump.

Monarch Missile Master Copying Lathe

In the illustration is shown the Missile Master copying lathe built by the Monarch Machine Tool Co., Sidney, Ohio, U.S.A., for performing precision conventional and profile turning, boring, and surfacing operations on components such as nose cones for missiles, airframe parts, and hemi-spherical and elliptical domes. The lathe will swing maximum diameters of 85 in. over the bedways, and 67 in. over the cross slide, and can be supplied with different bed lengths, in steps of 48 in., to give capacities up to 300 in. between the centres.

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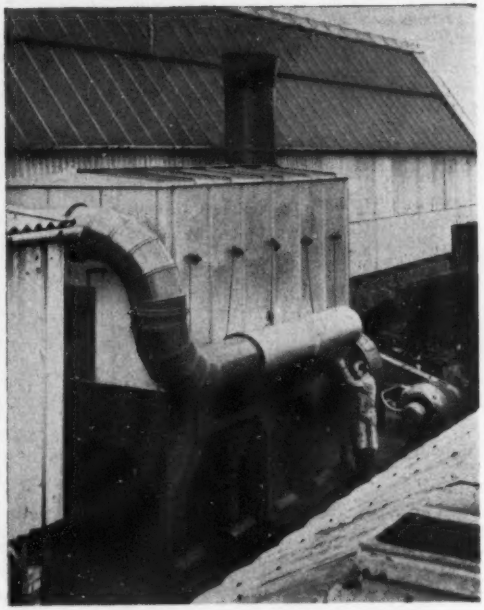

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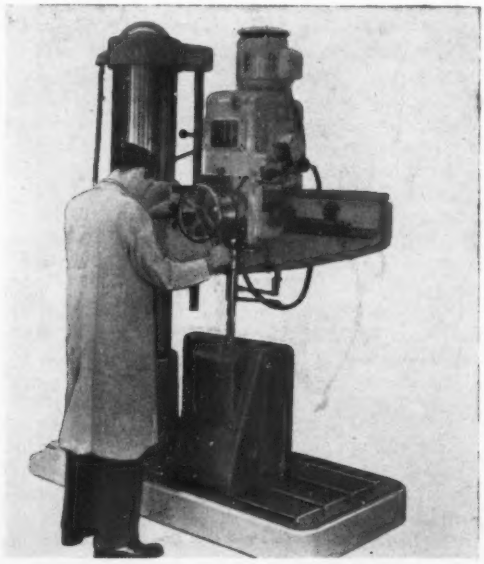

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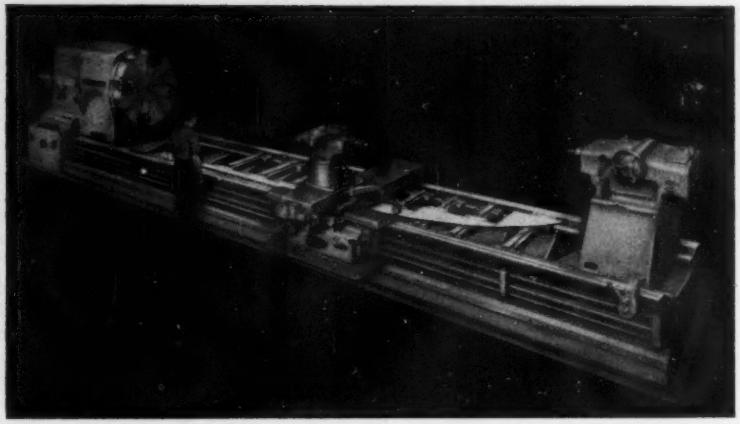


Monarch Missile Master Copying Lathe

8-speed gearing through a pinion in mesh with a ring gear at the rear of the 50-in. diameter faceplate. With the latter arrangement, when the highest speed of the gear drive is engaged, for example, adjustment of the motor speed enables a constant peripheral cutting speed of 150 ft. per min. to be maintained, for turning workpiece diameters ranging from 19 to 71 in. A control system can be provided to enable stepless variation of spindle speeds to be obtained automatically by means of a template, which is mounted longitudinally when turning and boring is to be carried out, and transversely on the bed for surfacing cuts.

A slow-speed drive unit, available for mounting on top of the headstock, has a pinion which engages with the ring gear at the rear of the faceplate. This unit provides 8 spindle speeds ranging from ½ to ¾ r.p.m., which enable a peripheral work speed of about 6 in. per min. to be obtained for thread milling on diameters from 2½ to 67 in. If required, an 80-in. diameter faceplate may be mounted on the spindle.

The totally-enclosed feed gearbox, which is automatically lubricated, enables 48 screw threads from 2 to 112 per in. to be cut, and provides feeds from 0·00075 to 0·0421 in. per spindle rev. Gearing is incorporated in the saddle, which enables the ratio between the longitudinal and cross feeds to be adjusted to increase the work diameter range that can be turned at one setting. Variable-speed rapid power traverses, which are controlled hydraulically, are provided for the saddle and cross-slide, and may be engaged independently or simultaneously. It is stated that the sensitivity of movement obtainable in this way is such that adjustment of the saddle and cross-slide by hand is usually unnecessary.

Wide, flat guideways, with automatic lubrication, are provided for the saddle at the front and rear of the 54-in. wide bed, which has horizontal cross webs with channels sloping towards the rear to facilitate the disposal of coolant and cuttings.

The template is carried by adjustable support arms mounted between the bedways, and profile turning can be performed on workpieces with diameter variations of as much as 35 in. Provision is made for mounting templates at right-angles to the bed for profile facing operations. Movement of the hydraulically-operated copying slide is controlled by the company's Air-Gauge tracer head, which is held in contact with the template under a load of only 5 oz. The copying slide is arranged to swivel on the cross-slide for setting parallel with the work axis for profile facing, and at right angles for profile turning.

A compound slide, mounted on a swivel base on top of the copying slide, provides for adjustment of the cutting tool in relation to the work when setting is being carried out in readiness for profile turning. When conventional turning, boring, and facing operations are to be performed, the copying system can be disengaged by movement of a lever.

Mounted on separate vee and flat bedways, the tailstock has a 7¼-in. diameter barrel which will take a rotating centre or a twist drill. A 2-speed gearbox is incorporated, which enables fine feed and rapid travel to be imparted to the barrel by means of the handwheel.

Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2, are the distributors in this country for Monarch lathes.

Finny Tap Nose Lead Grinder

The machine shown in Fig. 1 has been developed by Tap Sharpeners, Ltd., 21b Station Road, Cheadle Hulme, Stockport, Cheshire, for accurately grinding the nose lead of taps. There are two forms of this machine, known as the Standard and the Universal, and it can be readily adapted for grinding the nose lead of reamers and centre drills,

also for grinding and relieving stepped drills. During grinding, oscillating and reciprocating motions are applied to the workpiece. A helical/radial relief is thus imparted, which ensures the necessary clearance for the trailing edges of the lands with adequate support for the cutting edges.

The workhead, with angular table and tailstock, is supported as one unit on two trunnion bearings, one of which is centrally situated beneath the workhead, and comprises two extra precision bearings, set to eliminate end play. The other bearing is placed towards the rear of the table, and is of the roller type. The work-head, which is totally-enclosed and incorporates oil bath lubrication for the spindle drive, houses two cam and lever mechanisms. One of these mechanisms imparts a longitudinal reciprocating movement to work-head spindle, and the other provides the oscillating motion for the trunnion-mounted bed. The cams are changed to suit the number of flutes in the tap, but the same cams are suitable for right- and left-hand tools of otherwise similar form, it merely being necessary to change then from one spindle to the other.

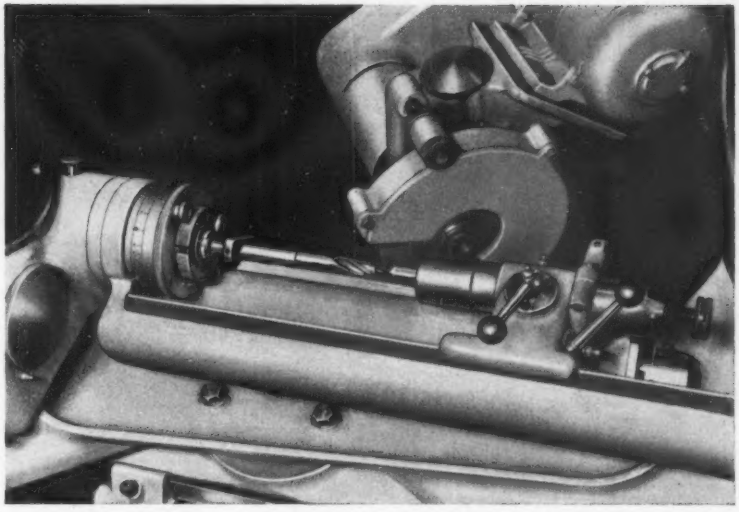


Fig. 2. Close-up View of the Finny Tap Nose Lead Grinding Machine Set Up for Grinding a Stepped Drill

Fig. 1. Finny Tap Nose Lead Grinding Machine

A spring-loaded tailstock quill, which is free to slide in its housing accommodates the axial movements of the work-head spindle. An adjustment is provided for varying the loading of this spring, to suit the weight of the tool between the centres. Drive to the work spindle is taken from a motor-driven reduction gear, which provides steplessly-variable speeds ranging from 6 to 30 r.p.m. Speed changes are made by means of a hand-wheel at the front of the machine. The complete work-head unit is mounted on a swivelling slide carried on the main table of the machine, which can be traversed, by hand, on the bed by rack and pinion, driven through worm reduction gearing.

In the close-up view Fig. 2 can be seen the calibrated driving plate on the workhead. There is a slipping mechanism incorporated in the drive which will accommodate any misalignment between the square end of the tap and the flutes. It is necessary only to place the tap between the centres and to ensure that any flute is centrally-aligned with a reference line on the driving plate. In Fig. 2, the machine is shown set up for grinding a stepped drill. The grinding head is mounted on

a vertical column, carried on a slide at the rear of the machine, and the spindle is driven, through a flat belt, by a ½-h.p. constant-speed electric motor. On both types of machine, the wheel-head can be swivelled in the horizontal plane, but, on the Universal machine, the head can be adjusted vertically on the column.

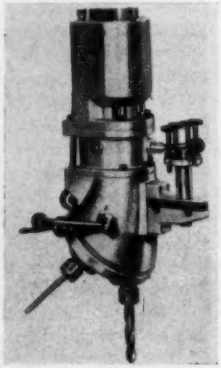
For flute grinding operations, a special semi-automatic indexing head can be provided, arranged for two, three, four, five, six and eight divisions. The head will index within 0·0005 in. on a 4-in. diameter circle. The machines can be arranged for wet or mist-coolant grinding, and will admit work up to 18 in. long by 5 in. diameter, with a maximum weight of 25 lb.

Boromat Multi-spindle Drilling Head

The Boromat multi-spindle drilling head, here shown, has been introduced by the German firm of Sigloch & Schrïeder, for whom the selling agents in this country are Embassy Machine & Tool Co., Ltd., 248 Watford Way, Hendon, London, N.W.4.

Developed from the company's type MBK unit (described in MACHINERY, 88/903—1/6/56), the head can be used on most types of drilling machines, and is available in three sizes which will accommodate $\frac{5}{16}$-, $\frac{13}{32}$-, and $\frac{23}{32}$-in. twist drills. Collet-type holders are provided, but standard collet chucks may be used on the $\frac{5}{16}$- and $\frac{13}{32}$-in. capacity heads, if desired. Twist drills with Morse taper shanks can be employed with the $\frac{13}{32}$- and $\frac{23}{32}$-in. capacity units. All the heads in the range can be fitted with tapping attachments.

A speed reduction gear box is available which can be interposed between the upper and lower parts of the cast iron body, as shown. It may be brought into use by means of a lever, or automatically, for driving any or all of the drilling spindles. In this manner, speed reductions in the ratio of 2·7 to 1 on the smallest head, and 3 to 1 on the intermediate and largest sizes can be quickly obtained for such operations as reaming, tapping and counter boring.



Sigloch & Schrïeder Boromat Multi-spindle Drilling Head

The upper part of the body is designed for clamping to the quill of a drilling machine, and the drive from the spindle is transmitted by a taper shank to a central spindle with a spring-loaded dog clutch member at the lower end, which engages with mating parts at the upper ends of the ball-bearing mounted drilling spindles. With this arrangement, only the spindle in the vertical position is rotated. A locking mechanism is incorporated, which prevents disengagement of the dog clutch when heavy cuts are being taken.

Indexing of the inclined spindle carrier can be effected by means of a second lever, or automatically, by a push rod, at the end of the upward travel of the drilling head. Initial movement of the lever or push rod causes the spring-loaded dog clutch member to be raised clear of the mating member, so that the drive to the drilling spindle is disengaged before the carrier is indexed. Upon completion of the indexing motion, the mating parts of the dog clutch are again brought into mesh, and the carrier is located, positively, by a spring-loaded plunger which engages with one of a number of slots in a hardened steel ring.

Adjustable stops, for use when holes are to be drilled to pre-determined depths, are mounted on a turret which is carried in a bracket at the front of the body, and is indexed simultaneously with the spindle carrier.

Snyder Semi-automatic Vertical Boring Machine

In the accompanying illustration is shown a semi-automatic, vertical boring machine which has recently been introduced by the Snyder Tool & Engineering Co., Detroit, 7, Michigan, U.S.A., who are represented in this country by Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, Battersea, London, S.W.11. Designed to facilitate the machining of heavy components such as the railway wagon wheels shown, with weights up to 700 lb., the machine has two hydraulically-operated 5-jaw chucks mounted on a table which can be traversed to bring either beneath the spindle. Power for the operation of the chucks, the movement of the table, and the feed of the spindle, is supplied by a separate unit. The spindle is 7 ft. long, and is supported on two taper roller bearings at the top and one at the lower end. It is driven by a 75-h.p. variable speed motor, and speeds suitable for a variety of bore sizes can be obtained.

With the arrangement shown, cast or forged steel wheels are rough and semi-finish bored to diameters ranging from 6⅜ to 7⅜ in., with the aid of special flanged boring bars, up to $\frac{1}{4}$ in. of stock being removed per side, in a time of 70 sec. The boring bars are fitted with throw-

Snyder Semi-automatic Vertical Boring Machine for Components Weighing up to 700 lb.

away carbide inserts, which are clamped in position, two square roughing and two cylindrical semi-finishing tools being arranged alternately, 90 deg. apart. A surface speed of 225 ft. per min. is normally employed, and the spindle is fed at the rate of $\frac{1}{16}$ in. per rev. No coolant is employed. When it is installed in the production line, the machine will be provided with automatic equipment for unloading and loading wheels in the chuck which is in the withdrawn position, and it is anticipated that an output of 48 wheels per hour will be obtained.

MachinLoder Fork-lift Truck

A feature of the MachinLoder pedestrian-controlled fork-lift truck introduced by Trucks & Pallets (Stackers) Ltd., Gas Street, Birmingham, 1, is that there are no projecting pieces in front of the mast, which can consequently be brought close to the bed of a machine, as shown in the figure, to facilitate loading and unloading heavy workpieces.

Intended for hand towing only, the truck is claimed to be particularly suitable for operation in confined spaces, and is available with capacities for loads up to 500, 750, and 1,000 lb., with the centre of gravity at a distance of 12 in. from the base of the 24-in. long forks. Vertical movement of the forks, through a maximum distance of 4 ft. 6 in., may be obtained by means of a 3-speed hand-operated hydraulic pump, or a pump driven by a battery- or mains-operated motor.

The range also includes trucks with battery-operated motor drives for the traversing motions, which will handle loads up to 1,000 and 2,000 lb. with the centre of gravity at a distance of 24 in. from the base of the forks. On these trucks, the vertical movement of the forks is 6 ft. A

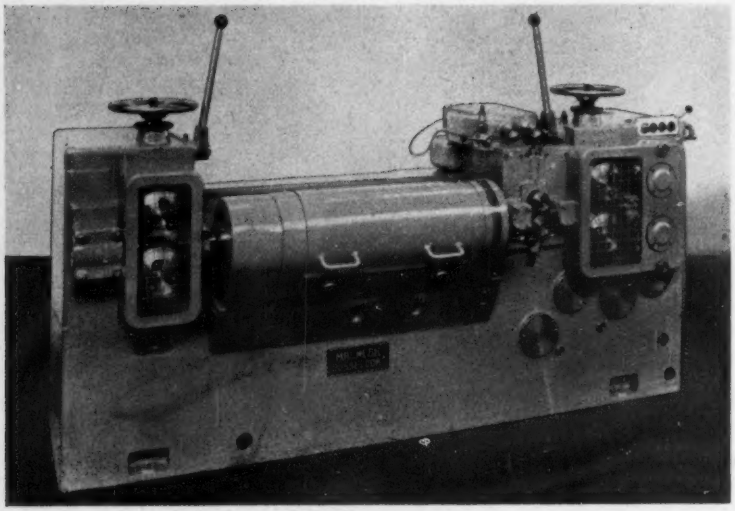
The MachinLoder Fork-lift Truck is Particularly Intended for Loading Heavy Workpieces on Machines, as Here Shown

20-in. long crane jib, squeeze clamps, and a roller platform, are available for attachment to the carriage in place of the forks.

Malmedie Type WRM. 20 Wire Straightening and Cutting-off Machine

In the figure is shown the type WRM.20 wire straightening and cutting-off machine recently introduced by the German firm of Malmedie, who are represented in this country by Stuart Davis, Ltd., Much Park Street, Coventry.

This machine will handle steel wire in coil form from $\frac{1}{4}$ to $\frac{5}{8}$ in. diameter, with a maximum tensile strength of 35 tons per sq. in., at rates



Malmedie Type WRM.20 Wire Straightening and Cutting-off Machine

of 200, 300 and 400 ft. per min., and the lengths of the pieces cut off can be varied steplessly from 9 to 64 ft. In operation, the wire is partly straightened by feed rolls at one end of the bed, and is gripped by pull-out rolls at the other end, the drive to these being taken from a 20-h.p. motor. A straightening unit, driven by a separate 25-h.p. motor, is usually mounted between the feed and pull-out rolls, alternatively, horizontal and vertical straightening rolls can be provided, if required. Measuring rolls which make contact with the wire and control the length of the cut-off pieces are mounted between the straightening unit and the pull-out rolls. Two rotating cutter heads, which move in opposite directions, are automatically brought into use by the action of a cam-operated electro-magnetic clutch.

All important bearings and guiding surfaces are lubricated by a single pump. The machine weighs approximately 4 tons 18 cwt.

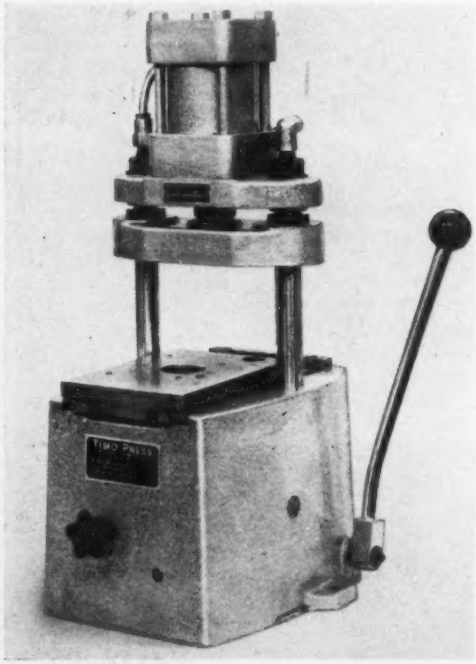
Timo Second-operation Pneumatic Press

T.A.I.P. (Engineers), Ltd., 38 Tewin Road, Welwyn Garden City, Herts., have recently introduced the Timo second-operation pneumatic press shown in the figure.

A feature of the design is that the work table, which has a travel of 2¼ in. on dovetail guideways, is moved to a position at the front of the bed, as shown, to facilitate loading and unloading work-pieces, when the slide is returned to the top of its stroke at the end of the operating cycle. Movement of a ball-ended lever which can be mounted on either side of the bed causes the table to be returned to its working position, and the air-cylinder-operated slide then performs the working stroke. The table, which has a central 1½-in. diameter hole, is positioned by the slide during the operating stroke.

When a stop plate on the bed has been removed, the table can be brought clear of the guideways, towards the rear, for maintenance purposes, by movement of the operating lever.

The slide has a fixed working stroke of 1 in.,



Timo Second-operation Pneumatic Press

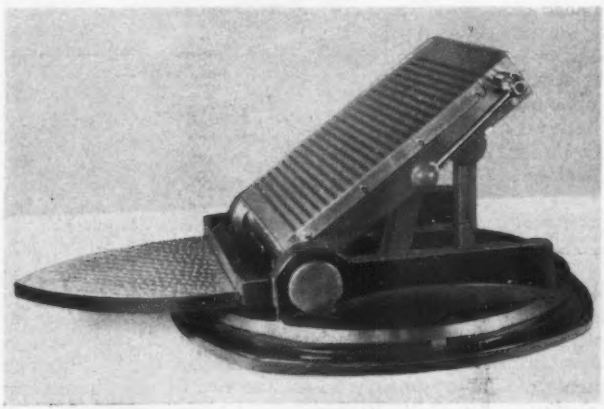
and an adjustment of ⅛ in., 3½ in. of daylight being obtainable. A force of 706 lb. is applied to the work when compressed air at 100 lb. per sq. in. pressure is admitted to the cylinder. The press is intended for operation by compressed air at a maximum pressure of 150 lb. per sq. in., and a knob is provided for varying the working speed of the ram.

Fimax Sine Angle Magnetic Chuck

Panton & Webb, Lavender Hill, Tonbridge, Kent, have recently extended their range of Fimax non-electric magnetic chucks to include the type here shown.

Designated 1412 SC, the new chuck has a 14- by 12-in. working surface, and may be tilted by a screw-operated link arrangement, and turned in the horizontal plane on a swivel base. Two sets of slip gauges, of the same height, are interposed between separate rollers on the table and raised pads on the swivel portion, for setting in the vertical plane. By means of the link arrangement, the rollers are held lightly in contact with the slip gauges, which thus support the table so that fairly heavy cuts can be taken on the work. The distance between the pivot pin and the setting rollers is 10 in.

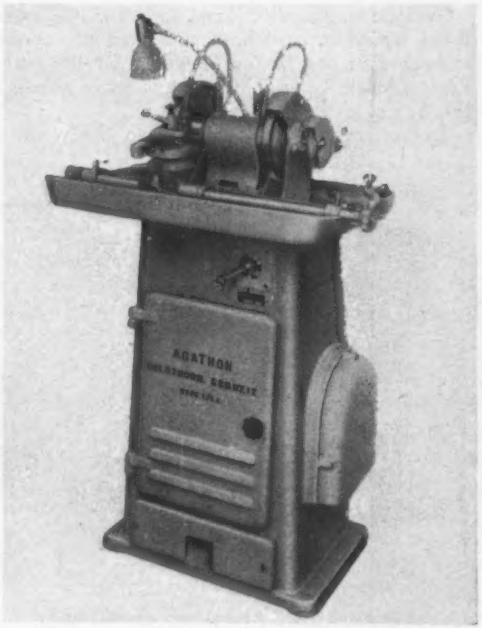
Settings in the horizontal plane are usually made with reference to a scale round the periphery of the large-diameter swivel portion. If required, a bracket can be fitted, as shown, to take a 10-in. sine bar mounted on its side, and accurate settings for angle can then be obtained with the aid of a dial indicator. The chuck has closely-spaced pole pieces which enable parts with small surface areas to be firmly held.



Fimax Sine Angle Magnetic Chuck

Agathon Tool Grinding and Lapping Machine

The Agathon cemented-carbide tool grinding and lapping machine shown in the figure is now being distributed in the United Kingdom by



Agathon Tool Grinding and Lapping Machine

Tornos Sales Company, Broadgate House, Coventry. Occupying a floor space of 33 in. by 24 in. and with a spindle height of 41 in., this machine is equipped with grinding and buffing wheels, the working surface of the latter being impregnated with diamond dust. A compound-angle tool rest enables cutting edges to be accurately ground and lapped, and an attachment (not shown) is available for grinding chip breakers. Tool holders of other forms can also be supplied.

A wide range of wheels is made for grinding different materials. Double-ended wheels are recommended, so that all tool edges can be correctly ground with the wheel rotating in one

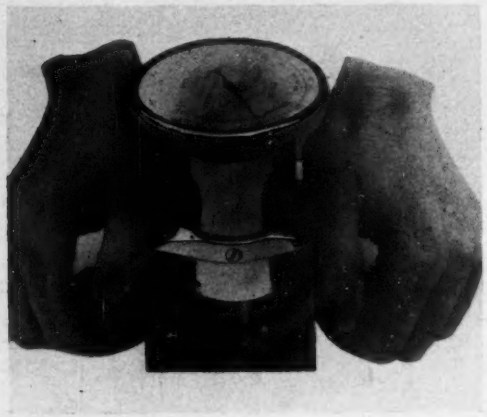
M

direction. The spindle is driven at 3,000 r.p.m. by belt from a ½-h.p. motor when 6-in. diameter grinding wheels are fitted. For 7-in. wheels, a ¾-h.p. motor is required.

Burton Mark 3 Portable Hardness Tester

William O. Bullock & Sons, Ltd., 126 Rodbourne Road, Swindon, have been appointed sole concessionnaires in the United Kingdom for the patent Burton Mark 3 portable hardness tester shown in the figure.

In use, the tester is applied to the work, as



Burton Mark 3 Portable Hardness Tester

shown, and a handpiece is depressed, with the result that a diamond indentor is brought into contact with the surface. Continued movement of the handpiece causes the indentor to be pressed into the work under a pre-determined load, for a maximum depth of 0·005 in. A reading which corresponds to the hardness value is then obtained on a large-diameter dial-type indicator. Scales of different colours are provided which give direct readings in Vickers pyramid, Brinell, and Rockwell values.

The instrument is available in different types, one of which gives full scale readings for Vickers pyramid numbers from 80 to 1,200, Brinell from 80 to 630, and Rockwell C from 30 to 70, in accordance with B.S.S. 860:1939. A second instrument gives full scale readings in Vickers pyramid numbers from 35 to 300.

Another type conforms to the requirements of the S.A.E. Handbook, 1949, and provides readings of Rockwell A, B and C values from 30 to 90, 40 to 100, and 0 to 70. A fourth hardness tester corresponds to the German specification D.I.N. 50-150, and the full scale readings obtainable range from 80 to 1,200 Vickers pyramid, 80 to 420 Brinell, 35 to 99 Rockwell B, and 20 to 70 Rockwell C.

Jones-Shipman Type 1712 Universal Machine Vice

A. A. Jones & Shipman, Ltd., Narborough Road South, Leicester, have recently added the type 1712 universal machine vice, here shown, to their range of products.

This new vice has 4-in. wide by 1⅝-in. deep hardened steel jaws, with a maximum opening of 3 in. It can be tilted through an angle of 90 deg., and swivelled on the base through 360 deg., scales being provided to facilitate setting. There is a central clamping screw in the base, fitted with two threaded rings which are tightened and released

Jones-Shipman Type 1712 Universal Machine Vice

with the aid of a tommy bar. By tightening one of these rings, both the swivel and tilting portions are clamped, whereas the second ring provides for securing the swivel member only. Weighing approximately 52 lb., the vice occupies a space of 12 by 10 in., and has an overall height of 7⅝ in. when the tilting portion is horizontal.

Setting Gauge for Grinding Operations on Internal or External Cones

By CHARLES MINAIRE*

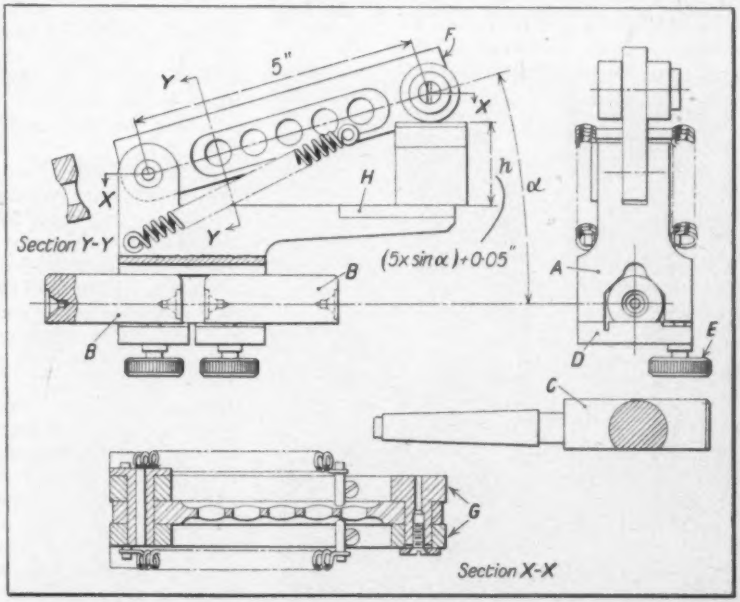
The equipment shown in the accompanying illustration has been designed to facilitate the setting of workpieces in preparation for grinding internal or external conical surfaces. Such workpieces cannot be set-up readily with sufficient accuracy by means of the graduations provided for the swivelling table on a grinding machine, and it is usual to set the table and work by trial-and-error methods. In this connection, restrictions are imposed by the amount of material that is to be removed from the workpiece, and, in any event, such methods are tedious and waste time. The equipment may also be employed for setting a taper-turning attachment of a lathe.

The gauge has a body *A* which is machined to provide a V-section seating, wherein can be fitted the two bars *B*, each with a flat on one side. These bars are provided with protected centre-holes at each end, and are ground accurately straight and parallel, with a smooth finish. A range of different bars is made to cater for work-pieces of different lengths, and to avoid any errors due to misalignment of the machine centres at extreme settings. There is also a number of alternative bars, as indicated at *C*, with male taper ends to suit the sockets of the spindles of the grinding machines that are to be used. Either type of bar can be secured in the gauge body by clamp plates *D* and screws *E*.

At one end of the body is pivoted an accurate straight-edge *F* which, at the end remote from the pivot pin, carries a pair of discs *G*. The distance from the centre of the pivot pin to the centre of the discs is exactly 5 in., and the discs are of the same diameter within very close limits, and this diameter is equal to twice the height of the pivot centre from the platen *H*, minus 0·1 in.

The arrangement of the setting gauge is such that when the discs rest on a 0·05-in. thick slip gauge, the datum face of the straight edge is parallel to the common axis of the bars *B*. Two tension springs connect the body *A* and the straight edge, and ensure that the platen and discs are held in contact with the slip gauges placed between them.

In use, the gauge is supported between the centres of the grinding machine, by using the bars



This Gauge, which is Based on the Sine Bar, has been Developed to Facilitate Setting-up a Grinding Machine or Lathe for Producing an Internal or External Conical Surface

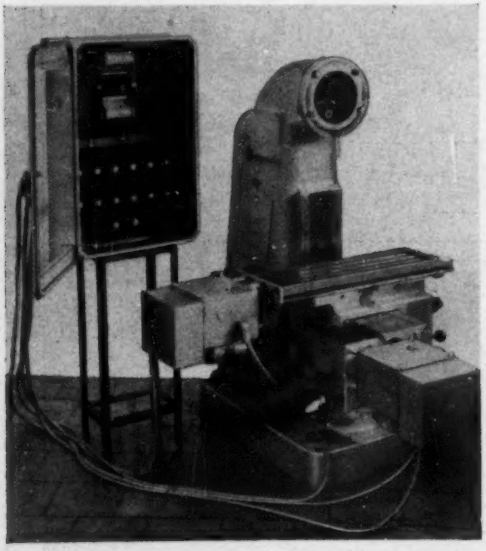
* Chief of Metrology, National Arms Factory, St. Etienne, Loire, France.

B, with the datum face of the straight-edge vertical, or is mounted on the bar *C*, fitted in the machine spindle, depending on the method to be adopted for supporting the workpiece. Slip gauges are placed between the platen and the discs *G* to set the straight edge at the required angle (α), the height (h) of the slip-gauge stack being derived from the formula $h = 5 \sin. \alpha + 0{\cdot}05$ in. The table of the machine can then be adjusted until a dial gauge mounted on the wheelhead of the machine shows the same reading at either end of the straight edge.

Airmec Automatic Co-ordinate Setting Equipment

Airmec, Ltd., High Wycombe, Bucks., have introduced automatic co-ordinate setting equipment, known as the type 271, which, in a fairly simple manner, provides for accurate remote control of the measuring screws of a co-ordinate table, and can readily be fitted to existing machines. In the figure, the equipment is applied for controlling the table and saddle motions of a machine. The table position may be set-up manually by means of knobs and dials, or automatically by punched paper tape which contains co-ordinate information for as many as 600 operations. When using punched tape, information may also be recorded for tool selection, a choice of 10 tools being available for every recorded co-ordinate setting.

The system operates by measuring, very accurately, the total angular rotation of the lead screws, this function being performed by Airmec type 242 positioner units, the design of which is the subject of a patent application. Features incorporated in this unit to improve the basic accuracy obtainable from a system which relies on lead screw precision, include provision for eliminating backlash, by arranging that final approach is always from the same direction, and facilities for correction of cumulative lead screw errors by means of a cam.



Machine Equipped with the Airmec Type 271 Automatic Co-ordinate Setting Equipment

No valves are used in the equipment, operation being controlled, very simply, by low-voltage, direct-current switching circuits, incorporating robust relays and precious metal contacts. A particular feature of the system is that the positioner measures absolute angle, and not change of angle as in most impulsing systems. Consequently, after any interruption or mains failure, the table is automatically positioned correctly, and no re-setting for zero is necessary. A sequential coding system is employed for the paper tape, which enables the latter to be prepared on a standard keyboard punching machine, and the final digit represents 0·001 in.

Drive to the lead screw is taken from a gearbox which incorporates two electro-magnetic clutches for the rapid traverse and slow approach speeds, and is driven by belt from a ¼-h.p. reversible motor mounted beneath, as may be seen in the figure. The use of clutches for speed changing reduces inertia in the system to a minimum, and it is stated that a setting accuracy of 1 deg., representing 0·0003 in. with a 10 t.p.i. lead-screw, can readily be achieved. The maximum lead-screw speed is normally 600 r.p.m., which gives a traverse rate of 1 in. per sec. with a screw of 10 t.p.i. With the slow-speed clutch engaged, an approach speed of $\frac{1}{25}$ of the traverse rate is obtained, and an additional change of speed can be provided if a 2-speed driving motor is employed. Push-button controls for fast and slow inching, in forward and reverse directions, are provided on the gearbox. Larger gearbox and clutch units can be supplied for use with the standard positioners, if heavier duties are involved.

The positioner unit is normally attached to the

rear face of the gearbox, as shown, and coupling may be direct, or through backlash-free gears. For a 10 t.p.i. lead-screw, direct coupling is convenient, but for lead-screws of other pitches, gearing may be interposed to ensure that the drive shaft of the positioner makes one revolution for each 0·1 in. moved by the machine table. Alternatively, a scale factor must be employed when preparing the punched tape. Four indicators, observed through small windows in the end of the unit, show the shaft position expressed in co-ordinates. As already mentioned, a lead-screw corrector cam is incorporated in the positioner unit, a lift of 0·2 in. being normally required for 0·001 in. of correction. The control and programme unit, which houses the tape reader and the knobs for manual selection of co-ordinate positions, may be arranged for either wall or floor mounting.

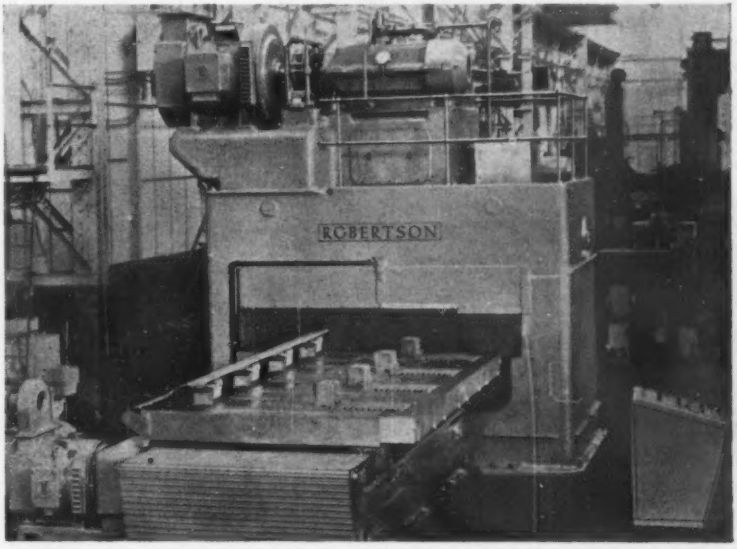
For automatic working, under tape control, an electrical signal is provided to start the machining operation when the table has reached the correct position. At the same time, the various control circuits are disconnected to ensure that no further table movement can take place, and a signal can be provided to operate table clamps, if that function is required.

As the machining operation is being performed the tape progresses to the next information group, and upon completion of the operation, a signal is transmitted to initiate the co-ordinate setting movements and the next machining cycle. The machine can therefore operate unattended until the entire machining programme has been completed, and an aural signal is then sounded, and the tape is automatically re-wound, in preparation for loading another workpiece.

Large Ingot Milling Machine

A large ingot milling machine, shown in the accompanying figure, has been built by W. H. A. Robertson & Co., Ltd., Bedford, for the American Brass Co., and will be installed in the works at Terre Haute, Indiana, U.S.A. It will be used for milling the faces of cast aluminium and alloy ingots up to 60 in. wide by 12 in. thick by 120 in. long, to remove imperfections before the material is rolled into strip, and subsequently into foil. If these imperfections are not removed, there may be serious faults in the finish-rolled material.

Electrical equipment, all of which was supplied by The English Electric Co., Ltd., Stafford, includes a 200-h.p. D.C. motor for driving the milling cutter, and a 6-h.p. D.C. motor for the ingot carriage, both supplied from a Ward-Leonard generator set which is driven by a 265-h.p. A.C. motor. The cutter can be run at any desired speed from 2,000 to 4,000 ft. per min. Forward speed of the ingot carriage can be varied, and it has a fast return speed, the cycle of operation being completely automatic. Push buttons and switches, on a desk adjacent to the milling machine, provide for the control and operation of these drives.



Large Robertson Ingot Milling Machine Built for Export to U.S.A. The Machine will handle Billets up to 60 in. Wide by 12 in. Thick by 120 in. Long

Fritz Wendt Tool Sharpening Machines

Shown in Fig. 1 is a recent addition to the range of tungsten-carbide tool sharpening machines made by the German firm Fritz Wendt K.G., Düsseldorf. Known as the type WF 6000, it embodies the firm's patented arrangement whereby sharpening is effected by a diamond-impregnated, resin-bonded lapping block, which is reciprocated horizontally and vertically. With this method, it is claimed, an exceptionally high surface finish is produced on the tool, and under normal conditions the cutting life is considerably longer than that of a tool sharpened with a 180-grit rotating diamond wheel.

Two lapping blocks are provided, which are of dovetail form and clamped in a holder, as seen in the close-up view, Fig. 2. The horizontal reciprocating motion, at the rate of 2,800 strokes per min., is applied in a direction parallel with the axis of the holder, and the latter can be swivelled through 25 deg. in each direction, to produce the required front clearance angle on the tool. Vertical reciprocation is effected by a separate motor at the slower rate of 104 strokes per min., and this motion can be disengaged if desired. The work table can be tilted ±15 deg. from the horizontal, and height adjustment is provided by means of a handwheel which enables tools up to 2⅛ in. square to be sharpened. Coolant is supplied by means of a built-in pump unit, and illumination of the lap and work is provided by lamps housed in the cowl above the lap holder.

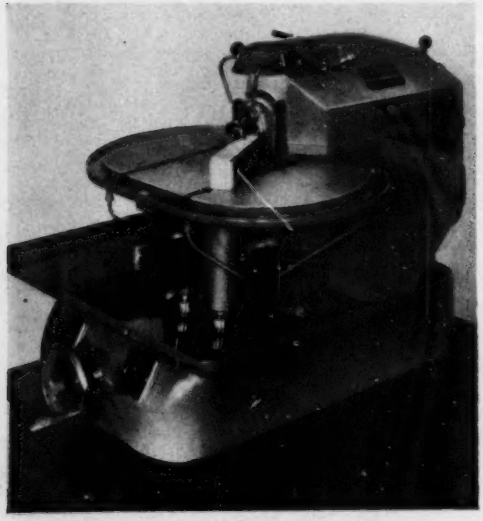


Fig. 1. Fritz Wendt Type WF 6000 Tool Sharpening Machine

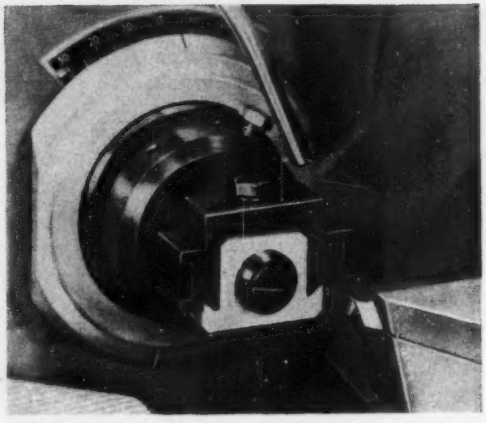


Fig. 2. Close-up View of the WF 6000 Machine, Showing the Horizontally- and Vertically-reciprocating Diamond-impregnated Lapping Blocks

Lapping blocks of various grades, for roughing and finishing, are available in several lengths, and there are two types, one of which is diamond impregnated on the vertical surface only, as seen fitted in the left-hand position, Fig. 2. The other type, fitted on the right, is provided, in addition, with a lapping surface along the lower edge, so that a chip breaker groove on the top of a tool can be finished, in the manner indicated. For this application the vertical reciprocating motion of the lapping block is disengaged. Silicon-carbide blocks, and ceramic blocks are also available, for sharpening high-speed steel and carbon-steel tools.

In a modification of this machine, known as the type WF 6000-V1, the plain tilting work table is replaced by a compound slide assembly provided with micrometer adjustments and fitted with a swivelling tool holder, for sharpening precision tools as used, for example, in the watchmaking and optical industries.

Tool sharpening machines of the original Wendt design, fitted with a single lapping block which is reciprocated horizontally in the transverse direction, are still being made, and the latest version,

known as the type WO-M, is of improved design. As on the type WF 6000 machine, the vertical reciprocating motion can be disengaged as desired.

CHIP BREAKER GROOVE GRINDING MACHINE

Fig. 3 shows a machine of patented design which the company have developed to provide an improved method of grinding chip breaker grooves with the recommended sloping step face, formed at an angle of 50 deg., for example. A cup-type diamond-impregnated wheel of 5 in. diameter, with a narrow face, is employed, and the 50-deg. angle is formed by combined vertical and horizontal movements, as indicated in Fig. 4. With this method, only one size and form of wheel is required for the entire range of tools handled, and improved wheel life, and a high degree of surface finish on the tool, are claimed, compared with the use of a formed, peripheral-type wheel. The machine can also be employed for grinding the flat surfaces of tools without chip breaker grooves.

The 17¾- 11¾-in. table can be tilted in two planes, and a longitudinal movement of 6 in., by hand, is provided along ball bearing ways. Vertical and transverse hand adjustments of 2¾ in. and 2¾ in. are available, and for producing the required sloping step face on the tool, these two motions are interconnected, and provision is made for applying a feed increment by movement of a hand lever, at each longitudinal stroke of the table. Coolant is supplied to the inside of the grinding wheel by a motor-driven pump unit, and is directed by centrifugal force to the cutting point. A setting bar on the wheel-head, with micrometer adjustment, readily enables the tool to be clamped in the required position on the table. The latter can be replaced by a radius grinding attachment for producing chip breaker grooves in round-nosed tools, and there is a motor-driven collet unit for handling button-type turning tools.

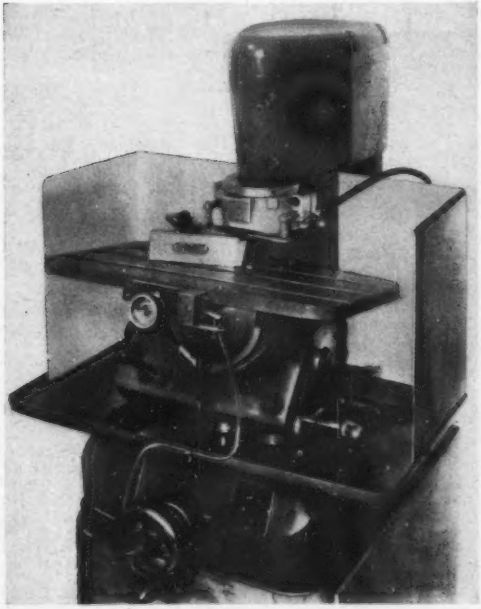


Fig. 3. Fritz Wendt Chip Breaker Groove Grinding Machine

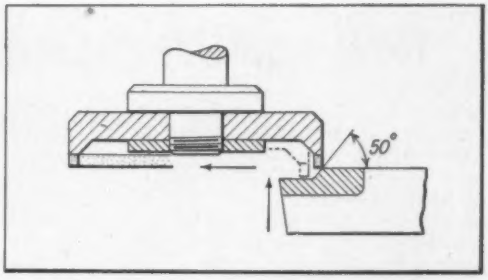


Fig. 4. Diagram Showing How a Cup Wheel is Employed for Producing a Chip Breaker Groove

A machine of similar design, but without the interconnecting arrangement for the transverse and vertical adjustments, and fitted with a horizontal spindle head, is also made, for general tool sharpening operations with a 5-in. diameter cup-type diamond wheel.

The exclusive distributors in this country for Fritz Wendt tool sharpening machines are the Elgar Machine Tool Co., Ltd., 172-178 Victoria Road, London, W.3.

NEVIMAG VARIABLE-SPEED DRIVE. The range of variable-speed drives manufactured by Lancashire Dynamo Nevelin, Ltd., Hurst Green, Oxted, Surrey, has been extended by the addition of the Nevimag drive, which has been developed to operate from an A.C. supply and to give accurate speed variation over a wide range. The drive consists of a transductor-controlled Ward Leonard set, which governs the speed of a D.C. motor over a range of 40 to 1. This drive is particularly intended for applications requiring up to 10 h.p., or for more powerful drives where regenerative braking is desirable or where heavy peak loads are involved.

New Heat-treatment Plant at the Works of Firth-Derihon Stampings

By the installation of a new heat-treatment plant incorporating the latest equipment, Firth-Derihon Stampings, Ltd., Sheffield Road, Tinsley, have concentrated all the heat-treatment facilities for parts produced at their Tinsley and Darley Dale works at the latter premises. Hitherto, each of the works had its own heat-treatment plant, and when the Darley Dale factory was built in 1941/2 a number of producer-gas fired, forge re-heating and small batch-type furnaces was installed. Conditions prevailing at that time necessitated the use of producer gas, and the plant was operated successfully up to 1956. However, in view of the close control which must be exercised in the heat-treatment of the high-quality alloy and carbon steels, also the nickel-based and titanium alloys, it was decided to abandon the use of producer gas in favour of town's gas, and plans for a new town's gas fired heat-treatment plant were drawn up. The installation was designed jointly by Gibbon Brothers, Ltd., Honeywell Brown, Ltd., Hartons, Ltd., and members of the Brown-Firth Research Laboratory, and the first stage of the work involved laying a 15-in. diameter by 12-mile long high-pressure main from Chesterfield to the Darley Dale works, by way of Matlock.

A high-capacity meter and a governor house were required, and extensive modifications were carried out to the existing internal gas distribution system. The actual heat-treatment plant installed comprises: three heat-treatment furnaces, two tempering furnaces, and one oil-quenching machine, all by Gibbons, Ltd.; one Gibbons-Van Marle turntable-type furnace charging machine; and a number of loading and cooling tables. A general view of the new plant is shown in Fig. 1, where the turntable charger is seen withdrawing a batch of turbine discs from the oil quenching machine. In the left foreground there is a forced air cooling table with a number of parts in position, and other equipment in this line includes loading tables and slow-cooling chambers.

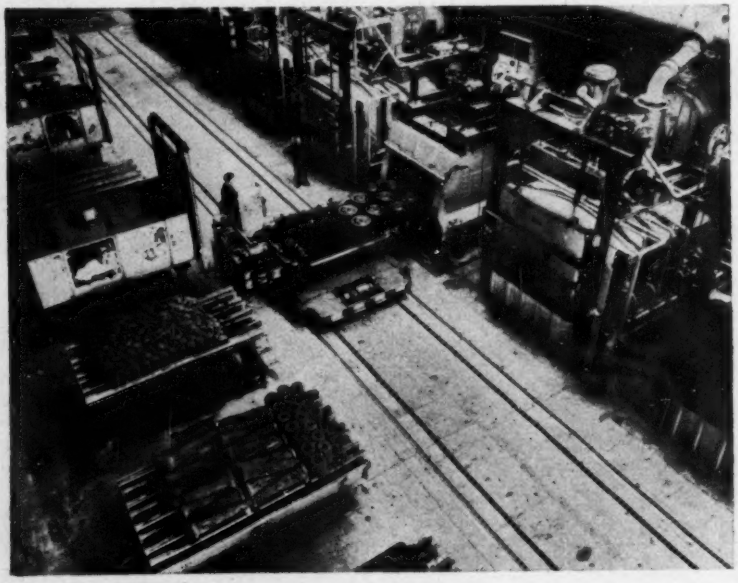


Fig. 1. General view of the new town's gas fired heat-treatment plant installed at the Darley Dale works of Firth-Derihon, Ltd.

The instrument control house is situated at the extreme left-hand end of the line of furnaces on the far side of the runway from the charging machine. There are two types of furnaces in this line, namely, a dual-system with forced re-circulation for temperatures within the range 200 to 750 deg. C., and a similar unit without forced re-circulation for temperatures between 750 and 1,250 deg. C. The tempering furnaces operate within the temperature range 200 to 750 deg. C., and are arranged for forced re-circulation. All the furnaces have common dimensions of 6 ft. 6 in.

wide by 11 ft. long by 3 ft. 3 in. high, under the arch, and can handle charge weights up to 5 tons.

The temperature distribution throughout each furnace can be controlled within very fine limits, and readings and recordings are taken at six different locations. The gas flow-rate and consumption of each furnace is monitored by Kent gas-flow recorders. Duplex air compressor and receiver units are mounted on the roof of the instrument house, and supply air for the operation of the pneumatic equipment on the furnaces. Waste gases from the furnaces are collected by an overhead main, whence they are discharged to atmosphere by way of a high-capacity exhaust fan and a chimney.

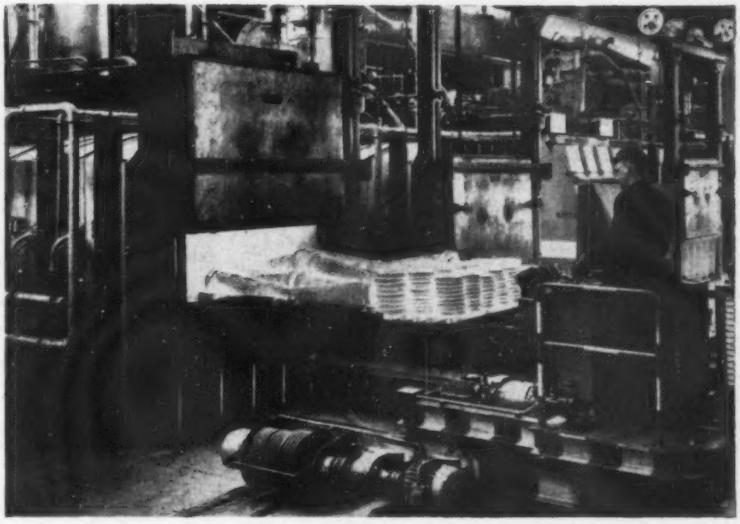


Fig. 2. The turntable-type furnace charging machine is here seen withdrawing a charge from a furnace for transfer to a forced-air cooling table

A close-up view of the turntable-type charging machine is given in Fig. 2, where a charge is being withdrawn from a furnace for transfer to a forced-air cooling table. This charger can be traversed along the length of the furnace line, and can handle loads up to a maximum of 5 tons. There are four electric motors, for actuating the raising/lowering, charging/discharging, traversing, and rotating motions, and current is supplied by way of the motor-driven cable drum seen in the foreground. The cable is arranged to pay-out into a narrow trench adjacent to the guiding rails.

The oil quenching machine, from which the charger is seen withdrawing a load in Fig. 1, is of the totally-enclosed type, with automatic door operation. During the quenching cycle, the load is automatically raised and lowered in the oil to ensure optimum flow conditions. The oil-cooler associated with this machine has a capacity of 27,000 gal. per hour, and water which is used as the cooling medium is passed through at the rate of 12,000 gal. per hour.

Parts for heat-treatment are delivered in stillages, fork-lift trucks being employed to move them within the plant, as required, and electric overhead cranes are provided for transferring heavier parts from the stillages to the loading tables. Depending on the weight and the section of the parts, they are loaded either on to special heat-resisting furnace trays or on to bearer-bars, but once a charge has been assembled on a loading table it remains as a unit throughout all subsequent operations. It is stated that the number of furnaces in this plant is only one quarter of that employed in the previous producer-gas fired installation.

Trade Publications

CINCINNATI MILLING MACHINES, LTD., Birmingham, 24. Booklet describing a number of different applications of Cincinnati dial-type milling machines. A table is included of the capacities and specifications of the various No. 2, 3 and 4, dial-type machines.

ALLDAYS & ONIONS, LTD., Sydenham Road, Small Heath, Birmingham, 11. Two leaflets giving a description and dimensions of the four sizes of U.F.1 grit arresters. This unit is primarily intended for use with a blacksmiths' hearth, and has been developed to meet the requirements of the recent Clean Air Act.

ACCESS EQUIPMENT, LTD., Maylands Avenue, Hemel Hempstead, Herts. Six illustrated catalogues covering the complete range of Zip-Up staging, which is available in a large number of different types. This equipment is made from light-alloy tubing which can be transported easily and erected quickly, and includes telescopic mobile platforms for overhead work; stairway-type permanent towers, up to 300 ft. high; mobile hydraulically-operated working platforms; and the Mountie range of mobile safety steps.

News of the Industry

Tyneside

In spite of the reduced rate at which orders for new construction and repair work have been received by the shipbuilding industry this year, and the cancellation of some existing orders, shipyards on the River Tyne are busily employed, and are likely to continue so for some time to come. Builders of marine engines and makers of other auxiliary equipment for ships also have good order books. In the electrical field there is much demand for steam power plants for supply undertakings, including the new nuclear power stations, and there is similar activity among the switchgear manufacturers. Although the demand for the smaller and standard type machine tools continues to be somewhat easy, there is a good volume of business in hand for the large-capacity and more specialized types. A number of works extensions recently completed, and others in progress, are indicative of confidence in the future.

NOBLE & LUND, LTD., Felling-on-Tyne, have orders in hand for heavy machine tools which will keep them busily engaged for a considerable period. These orders include several lathes with centre heights ranging from 27 to 72 in., the largest admitting 40 ft. between centres, and a turbine-cylinder boring and turning machine for the B.T.-H. works at Rugby. Among the planing machine on order are two 18 ft. by 6 ft. square machines, and a 35 by 14 by 9¼ ft. planer with cross-planing and deep end-planing features, which is due for delivery shortly to the North Eastern Marine Engineering Co., Ltd., Wallsend. Multiple-head plano-milling machines are on order with strokes of 18 and 20 ft., for machining work up to 6, 8 and 15 ft. wide. Among the special types, we noted a rail planing machine for points and crossings, and a horizontal face milling machine.

A steady influx of home and export orders is being received for Fluifeed cold sawing machines, of both the horizontal and vertical types, equipped with saws from 16 to 72 in. diameter. A 38-in. vertical machine is in hand for sawing broad flange beams, and two 24/28 in. ALCC automatic machines are for cutting stainless steel bars. One of the latter machines was under test at the time of our visit and 65 pieces were cut from a 7¼-in. diameter stainless steel bar in six hours. The latest addition to plant at these works is a Kearns Optimetric horizontal boring machine.

LUMSDEN MACHINE CO., LTD., Gateshead, have recently added a 140 by 40 ft. bay to their machine shop, which is to be equipped with a Heywood 10-ton overhead electric travelling crane. Orders are in hand for standard rotary- and reciprocating-table surface grinding machines, the former having tables from 24 to 100 in. diameter, and the latter, 12-, 24- and 36-in. wide tables, in lengths up to 16 ft. Retractable rotary table type machines are in steady demand from the motor-car industry, and our attention was drawn to a batch of die grinding machines in progress, of various sizes. A good demand is reported for the firm's two- and four-wheel tool grinding machines, and orders for oscillating tool grinders include machines destined for the U.S.A. A David Brown 48-in. gear hobbing machine is shortly to be delivered to the works.

LERCHE MACHINE TOOLS, LTD., Oakwellgate, Gateshead, are doing a steady trade in the various British and Continental machine tools and instruments for which they are the agents. Among the Continental machines are Heidenreich & Harbeck bevel gear generators, Reicherter hardness and spring testing machines, Kesel dividing machines and Carl Mahr precision measuring instruments. Our attention was drawn to the Kuhlmann universal engraving machine, which we hope to describe more fully in due course. This is a column-type machine operating on the two-dimensional principle, and the engraving head is supported by a special steering mechanism underneath the pantograph. Movement of the engraving head on the work table is controlled by the horizontal pantograph, a pin beneath the regulating slide meshing with a ball bearing above the engraving head. The ratio of the pantograph adjustment can be readily changed from 1-to-1 up to 1-to-100.

CHURCHILL GEAR MACHINES, LTD., Blaydon-on-Tyne, are well employed on the production of their various sizes of gear hobbing and gear shaving machines, and we understand that several interesting projects are under consideration in connection with automatic-loading, transfer-line machines. There is a steady demand for gear sound-testing machines, shaving cutters and throw-away tipped tools. Arrangements have recently been made with the Curtis Machine Corporation, of Jamestown U.S.A., and Carborundum, Ltd., Manchester, for the manufacture of abrasive belt grinding

machines, and at a later date we hope to describe two conveyor-type machines for grinding, polishing and deburring stock up to 4 in. wide by 2½ in. thick, and 10 in. wide by 4 in. thick, respectively, which have been built at the Blaydon works.

VICKERS-ARMSTRONGS (ENGINEERS) LTD., Elswick, Newcastle-on-Tyne, have a good order book for British Clearing mechanical presses, some of which are for Australian motor-car factories, and for manufacturers of pressed steel motor vehicle bodies and safes in this country. Presses are in hand with capacities of 250, 350, 450, 1,000, 1,600 and 1,950 tons of the single-, double- or triple-action types. The 1,950-ton press admits workpieces 15 ft. wide and is of the triple-action type. This machine, and a 1,000-ton press of the double-action type, are for Australia, and a 1,600-ton single-acting press is for the home market. Strip-feed equipment for use in conjunction with a line of presses is also in progress, and press brakes and hydraulic presses of various capacities on order.

Other activities include plate-finishing machinery for rolling mills, ordered by Davy and United Engineering Company, Limited, for the new works of the South Durham Steel & Iron Co., Ltd. This order comprises shearing machines, plate rollers, cooling banks, turnover arms, edge trimmers and scrap cutters. The heavier types of deck machinery for ships are now being built at these works, including winches, windlasses and steering gear. Rebuilding of the stores at the Elswick works is now being undertaken.

H. B.

Industrial Notes

THE GLOBE PNEUMATIC ENGINEERING CO., LTD., Romford, Essex, inform us that they have appointed Robert Kelly & Sons, Ltd., Machine Tool Division, Newington, Liverpool, 1, as sole selling and service agents in the Lancashire and Cheshire areas for their range of pneumatic equipment.

STEIN ATKINSON VICKERS HYDRAULICS, LTD., inform us that they have now opened branch offices at 33/39 Newhall Street, Birmingham, 3 (telephone No. Central 1593), and 9 Woodside Place, Glasgow, C.3 (telephone No. Douglas 8260). Mr. A. L. Dawson, A.M.I.Mech.E., and Mr. W. J. F. Cook have been appointed technical representatives for these offices, respectively.

ALFRED HERBERT, LTD., P.O. Box No. 30, Edgwick Works, Coventry, have been appointed sole selling agents in the United Kingdom, and Eire, for the range of planing machines and associated equipment made by Planers (Huddersfield), Ltd. The latter company is also prepared to consider the manufacture of special-purpose reciprocating machine tools to customers' individual orders.

SCAFFOLDING (GREAT BRITAIN), LTD., Willow Lane, Mitcham, Surrey, have formed a Protective Clothing Division, which is marketing an extensive range of such clothing for both factory and outdoor workers, including boiler suits, overalls, gloves, aprons, safety footwear, helmets, and goggles. These items are distributed from stocks held at the company's 36 branches throughout the country.

INVENTORS' EXHIBITION AWARD.—At the recent Brussels International Inventors' Exhibition, the Grand Prix and Gold Medal were awarded in respect of a steplessly-variable speed electric motor submitted by Mr. C. Brunt, managing director of the Armature Manufacturing Co., Chadderton. This motor, which has a speed range of 100 to 1 and requires no gearbox or external resistance, was selected from a total of 1,200 entries from 19 different countries.

BRITISH MOTOR CAR PRODUCTION AND EXPORTS.—During July, the British motor car industry had its best month ever, both in production and exports. The weekly production of cars was 21,367, and exports, delayed by the dock strike, averaged 12,550, with a value of £19,500,000, for the month. During the month 14,500 cars, mainly sports models, were exported to the U.S.A. and had a total value of £6,000,000.

B. O. MORRIS, LTD., Coventry, inform us that they have recently been appointed sole agents in this country for the range of Macolaepp lapping tools and accessories which are manufactured in Germany. Handlaps ranging from 180 to 500 grit are available, also lapping paste, and there is a wide selection of lapping wheels of the cup, peripheral, and double-sided types, with diameters from 2 to 10 in. Lapping sticks of half-round, triangular, and rectangular cross-section are also available.

AIRCRAFT EXPORTS.—The Society of British Aircraft Constructors state that the aircraft industry's exports for July totalled £14,676,796, the second highest figure ever recorded, and brought the January-July figure to £91,910,080, compared with £62,147,710 in the corresponding period last year. During July, the sale of aircraft and parts amounted to £10,013,317; aero-engines, £4,006,584; electrical appliances, £404,274; tyres, £44,006; and aeronautical instruments, £208,615. Leading buyers of aircraft and parts in July were Canada (£2,695,300), India (£2,044,541), Western Germany (£1,436,228), and the U.S.A. (£1,204,828).

THE INDUSTRIAL SECTION OF THE CENTRAL FILM LIBRARY, Government Building, Bromyard Avenue, Acton, London, W.3, have recently made a number of additions to the stock of films available for hire or free loan. Among these new films may be noted: *Variety Reduction*, a discussion, at an imaginary board meeting, of the arguments for and against a policy of variety reduction, and the implications of such a policy for design, production, sales, and accounting departments; *Take Care of Yourself*, in which a number of typical industrial accidents are considered, including those caused by unsuitable clothing, and the incorrect use of manual and mechanical handling methods and tools; and *Productive Maintenance* (in colour), showing how the introduction of a properly planned productive maintenance system can reduce the problems connected with breakdowns in engineering works.

Demonstration of the C-R Type P.5 Multi-tool and Profiling Lathe

The type P.5 automatic multi-tool and profile turning lathe, introduced a short time ago by Churchill-Redman, Ltd., Halifax, was demonstrated recently at the Birmingham showrooms of the distributors, Charles Churchill & Co., Ltd. A view of the lathe set up for one of the demonstrations is given in Fig. 1.

A description of this lathe was published in MACHINERY, 92/570—7/3/58, and it may be recalled that it has an overhead profile turning carriage mounted on a vertical bed, and a rear auxiliary in-feed slide, both of which are hydraulically operated. A maximum of four successive cuts can be taken on the work during a fully-automatic cycle, and for such operations, indexing circular templates with plate inserts are employed. Two sliding feeds, with maximum rates of 30 and 60 in. per min., also two spindle speeds can be brought into use automatically during any carriage cycle. The lathe swings a maximum diameter of 15 in., and admits 20 in. between the centres, and spindle speeds from 250 to 2,000 or from 125 to 1,000 r.p.m. can be obtained by means of pick-off gears.

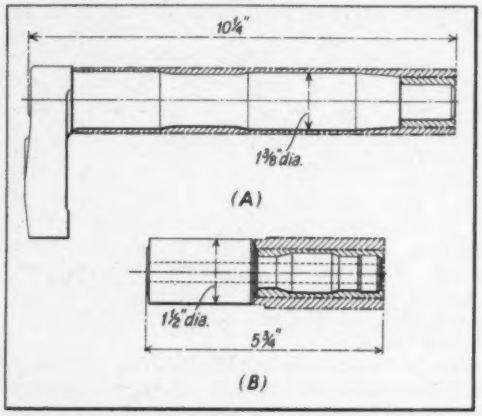


Fig. 2. Two components which were profile turned during demonstrations of the lathe shown in Fig. 1

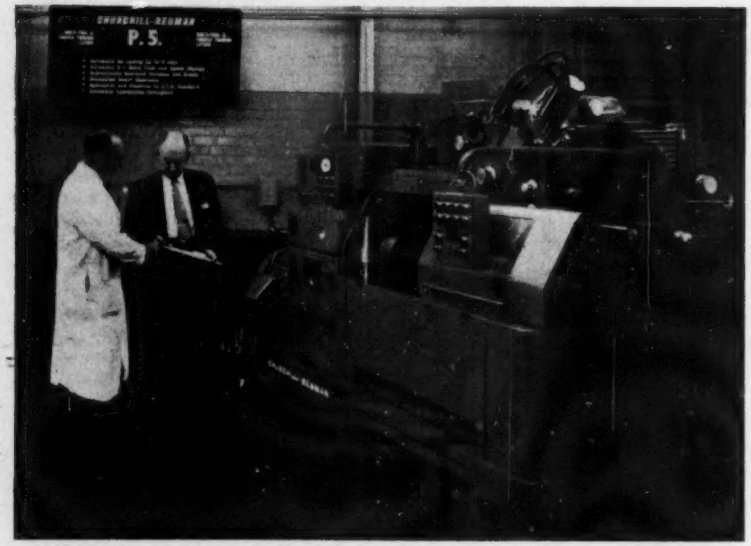


Fig. 1. A view of the Churchill-Redman type P.5 multi-tool and profile turning lathe set up for demonstration at the Birmingham showrooms of Charles Churchill & Co., Ltd.

In Fig. 2 are shown the principal dimensions of two components which were profile-turned during the demonstrations. The rocker shaft seen at *A* was machined from an EN 35 steel forging, at two passes of the carriage, in a cycle time of 34½ sec., with a spindle speed of 1,660 r.p.m. and a feed of 0·014 in. per rev. Copy-turning of the steering worm shown at *B*, from EN 363 steel bar, was carried out, also with two passes of the car-

riage, in 25 sec. Spindle speeds of 920 and 1,850 r.p.m. were employed for the first and second passes respectively, and the sliding feed was 0·016 in. per rev. A third component was machined from an EN 353 steel forging weighing 15½ lb., in two operations, which occupied cycle times of 54 and 67 sec. At the first stage, the weight of metal removed from the forging was 1½ lb., and the spindle speed was automatically changed from 600 to 1,200 r.p.m. Spindle speeds of 870 and 430 r.p.m. were employed for the second stage, at which the weight of metal removed from the work was 2 lb. A sliding feed of 0·012 in. per rev. was employed for both operations.

Other demonstrations of the type P.5 multi-tool and profile turning lathe will be given at the Colindale, London, showrooms of Charles Churchill & Co., Ltd., from September 22 to 26, and at the Halifax works of Churchill-Redman, Ltd., from October 13 to 17.

Course on Computing Systems

A 2-part course of lectures on electronic computing systems is being organized by the department of mathematics of the Sir John Cass College, Jewry Street, London, E.C.3. The first part will consist of nine evening lectures, starting on October 8, and the subjects to be covered include: computer codes; the construction of computers; the programming of computers; and computer schemes for data processing. Arranged to start on January 14, the second part of the course will occupy from eight to ten lectures and will be concerned with a review of the commercial applications of electrical digital computing systems, including costing, material control, sales and invoicing, and integrated data processing.

The course is intended for executives and others who are interested in the commercial application of electronic computers, and no prior technical knowledge will be assumed.

Applications for enrolment forms should be made to the secretary at the above address.

Books Received

ARTICLES ON STORAGE AND STOCK CONTROL. (Revised Edition.) Purchasing Officers' Association, Wardrobe Court, 146a Queen Victoria Street, London, E.C.4. 75 pp. (Price 6s. 0d., post free.)

This booklet, which contains reprints of articles from *The Purchasing Journal*, covers new developments in both techniques and equipment as well as the basic procedures for stock control in industry. The subjects include organization; punched-card and machine accountancy; standardization; classification; perpetual inventory; re-ordering quantities; deterioration; returnable container procedure; and handling equipment. There are numerous illustrations showing the layout of forms which are readily adaptable to individual requirements.

Exchange of Technical Information

(*Continued from page* 571)

solution of their problems that they have no time to "look up the answers" that may have been provided by others no less competent, are likely to find themselves at a growing disadvantage. It is sometimes contended that an intelligent man can normally rely on his own abilities and need only seek assistance from published data when he occasionally finds himself out of his depth. The literature of production engineering, however, can be of far wider value. It provides for the continual interchange of ideas which are by no means the monopoly of any one firm, industry, country or continent, and can point the way to innumerable improvements in practices well established that would otherwise escape attention. If the busy executive cannot directly take advantage of these facilities, it is essential for the future well-being of his company that the task should be allocated to a subordinate, who can at least ensure that nothing of outstanding importance passes unnoticed. It is equally important that information should be made readily available for future reference, and the great majority of firms will find that the cost of maintaining an effective technical library with facilities for such work is more than justified.

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10/9/58

BRITISH MACHINE TOOL

Exports of New Machine Tools

Countries	Vertical Boring Machines		Other Boring Machines		Drilling Machines		Grinding, Lapping and Honing Machines		Automatic Lathes		Capstan and Turret Lathes		Other Lathes		Screwing Machines	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
Commonwealth																
South Africa	—	—	15 (3)	585	388 (33)	9,512	623 (51)	16,102	—	—	521 (9)	25,880	552 (21)	17,241	15 (1)	575
India	243 (2)	11,261	2,599 (9)	101,482	1,300 (30)	37,573	1,629 (89)	61,560	—	—	1,694 (32)	74,096	933 (14)	38,639	152 (5)	11,278
Pakistan	479 (4)	14,515	—	—	6 (3)	214	101 (9)	3,786	—	—	—	—	—	—	—	—
Australia	—	—	257 (1)	8,327	888 (29)	19,198	133 (17)	3,338	282 (4)	17,178	482 (12)	22,102	486 (35)	21,908	100 (5)	8,737
New Zealand	—	—	34 (12)	844	35 (15)	880	90 (25)	2,595	—	—	40 (1)	1,583	214 (15)	6,387	—	—
Canada	350 (2)	7,806	18 (1)	407	399 (11)	8,059	450 (24)	17,008	70 (1)	1,546	102 (3)	4,207	1,054 (24)	33,789	—	—
Miscellaneous	3 (1)	178	2 (1)	152	602 (37)	19,846	401 (30)	12,861	—	—	103 (2)	5,144	763 (41)	24,124	6 (1)	187
Foreign																
Soviet Union	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sweden	170 (1)	4,200	1 (1)	250	30 (1)	1,061	25 (1)	815	—	—	12 (1)	424	3 (2)	78	—	—
Norway	—	—	—	—	9 (1)	205	1 (2)	212	—	—	66 (7)	4,026	16 (3)	605	—	—
Denmark	—	—	—	—	121 (5)	3,205	—	—	—	—	—	—	41 (4)	1,269	—	—
Western Germany	—	—	—	—	20 (9)	1,337	8 (5)	275	—	—	—	—	2,691 (12)	65,758	—	—
Netherlands	—	—	—	—	108 (6)	2,660	83 (9)	5,242	—	—	153 (7)	7,911	72 (6)	2,399	—	—
Belgium	—	—	—	—	12 (12)	342	200 (7)	7,079	—	—	55 (1)	1,944	54 (23)	1,729	—	—
France	127 (1)	3,733	32 (1)	1,227	49 (3)	1,190	210 (12)	13,501	1,188 (12)	56,936	235 (3)	9,288	131 (14)	4,511	—	—
Switzerland	—	—	—	—	15 (2)	838	53 (2)	2,240	—	—	15 (1)	929	93 (10)	2,891	—	—
Spain	290 (2)	23,667	361 (7)	23,100	447 (3)	8,662	937 (15)	48,429	256 (5)	19,643	235 (4)	10,870	63 (3)	4,130	1 (1)	118
Italy	—	—	—	—	90 (3)	4,060	25 (5)	1,497	117 (1)	5,801	—	—	35 (7)	849	—	—
U.S. America	535 (3)	12,950	—	—	273 (5)	7,748	807 (9)	15,419	257 (1)	9,339	—	—	710 (23)	28,338	88 (2)	4,858
Miscellaneous	—	—	24 (4)	1,273	428 (78)	11,086	749 (96)	32,171	589 (2)	26,206	649 (19)	30,688	1,662 (79)	52,155	58 (3)	1,773
Total	2,197 (16)	78,310	3,343 (40)	137,647	5,220 (286)	137,676	6,525 (408)	244,130	2,759 (26)	136,649	4,362 (102)	199,092	9,573 (336)	306,800	420 (18)	27,526
Amendments to previous accounts																
Commonwealth	—	—	+35 (—)	−39	−29 (−1)	−1,353	−23 (−1)	−733	—	—	+289 (+2)	+9,747	−200 (−3)	−4,910	+199 (+3)	+9,990
Foreign	—	—	−15 (—)	−450	+145 (+13)	+15866	−137 (−4)	−15400	—	—	—	—	— (−37)	−674	—	—

Total exports of reconditioned machine tools: Quantity: No., 202; Weight, 12,238 cwt.; Value, £64,003.
Total exports of imported machine tools: Quantity: No., 8; Weight, 434 cwt.; Value, £7,633.

Imports of New Machine Tools

Country of Origin	Boring Machines		Drilling Machines		Gear-cutting Machines		Grinding, Lapping and Honing Machines		Automatic Lathes	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
Western Germany	413 (3)	21,035	14 (8)	797	243 (2)	13,531	706 (33)	38,647	815 (19)	35,962
Belgium	—	—	—	—	—	—	—	—	—	—
France	—	—	—	—	—	—	5 (1)	332	—	—
Switzerland	268 (7)	25,411	170 (3)	5,816	47 (6)	5,834	308 (17)	28,786	665 (28)	42,502
U.S. America	537 (2)	32,045	—	—	953 (5)	75,279	725 (16)	87,482	919 (5)	55,978
Miscellaneous	421 (5)	21,028	4 (1)	138	—	—	589 (16)	27,831	298 (3)	12,121
Total	1,639 (17)	99,519	188 (12)	6,751	1,243 (13)	94,644	2,333 (83)	183,0.8	2,697 (55)	146,563
Amendments to previous accounts										
Western Germany	—	—	—	—	—	−54	—	—	−18 (—)	+72
Belgium	—	—	—	—	—	—	—	—	—	—
France	—	—	—	—	—	—	—	—	—	—
Switzerland	—	—	—	—	—	—	—	—	—	—
U.S. America	—	—	—	—	—	−40	—	—	—	—
Miscellaneous	—	—	—	—	−2 (−1)	−784	—	—	—	—

Total imports of reconditioned machine tools: Quantity: No., 17; Weight, 285 cwt.; Value £9,597

IMPORTS AND EXPORTS (Classified)

and Parts during May, 1958

Threading Machines		Milling Machines		Gear-cutting Machines		Planing, Shaping and Slotting Machines		Presses		Sheet Metal-working Machines		Sawing Machines		Other Machines		Machine Tool Parts*		Total	
Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt.	Value £	Quantity. Cwt. and No.	Value £
—	—	50 (1)	2,840	—	—	18 (3)	438	76 (8)	1,396	33 (2)	289	80 (8)	3,061	595 (38)	13,620	401	14,092	3,367 (178)	105,631
267 (11)	11,857	783 (8)	28,044	—	—	1,085 (16)	40,638	771 (14)	30,375	693 (34)	16,807	367 (4)	6,855	590 (57)	23,636	299	20,352	13,405 (325)	514,453
—	—	79 (2)	3,775	—	—	93 (2)	3,854	161 (4)	3,469	—	—	11 (2)	257	—	—	34	1,226	964 (26)	31,096
92 (1)	8,156	370 (7)	19,305	—	—	281 (7)	7,807	1,113 (24)	47,223	90 (1)	1,035	139 (1)	2,937	102 (27)	4,564	396	20,619	5,211 (171)	212,434
—	—	8 (1)	392	—	—	134 (5)	3,197	43 (7)	994	12 (3)	164	10 (3)	300	142 (19)	1,523	20	1,524	782 (106)	20,383
22 (1)	821	531 (12)	21,502	—	—	8 (1)	145	860 (8)	16,326	—	—	12 (2)	354	117 (9)	5,457	310	15,538	4,303 (99)	132,965
48 (4)	1,552	81 (4)	2,598	—	—	649 (9)	16,236	419 (25)	7,867	—	—	93 (18)	2,488	369 (37)	10,028	428	12,576	3,967 (210)	115,837
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	120 (1)	6,878	—	—	—	—	7 (1)	62	—	—	—	—	—	—	30	3,676	398 (9)	17,444
—	—	—	—	—	—	—	—	83 (1)	1,340	26 (1)	478	—	—	—	—	20	2,132	221 (15)	8,998
7 (1)	395	—	—	—	—	—	—	—	—	2,080 (1)	43,237	—	—	—	—	2	308	2,251 (11)	48,414
—	—	170 (2)	8,715	—	—	176 (2)	4,373	80 (1)	2,136	—	—	—	—	311 (9)	20,853	36	5,011	3,492 (40)	108,458
—	—	237 (3)	10,848	—	—	8 (1)	156	11 (7)	640	—	—	11 (1)	198	31 (4)	1,238	90	3,569	804 (44)	34,861
—	—	28 (1)	799	—	—	—	—	—	—	—	—	3 (2)	81	14 (2)	708	26	1,993	392 (48)	14,675
89 (1)	6,162	87 (4)	3,765	30 (2)	2,307	56 (2)	1,238	444 (3)	20,696	—	—	—	—	276 (10)	11,447	168	16,163	3,122 (68)	152,164
—	—	8 (1)	286	—	—	17 (4)	458	—	—	—	—	—	—	281 (3)	14,692	162	11,983	644 (23)	34,317
99 (3)	12,000	662 (6)	32,207	75 (2)	7,028	238 (1)	6,781	132 (1)	5,788	1,742 (3)	46,395	70 (1)	2,149	767 (10)	24,565	96	13,941	6,471 (67)	289,473
—	—	—	—	—	—	—	—	—	—	412 (1)	14,462	—	—	524 (2)	18,630	527	19,312	1,730 (19)	64,611
—	—	333 (5)	17,089	—	—	216 (2)	9,498	446 (3)	6,555	—	—	—	—	90 (3)	8,614	109	15,757	3,864 (56)	136,165
24 (2)	2,149	309 (5)	14,084	—	—	870 (38)	21,977	705 (42)	14,689	753 (11)	16,640	121 (21)	3,019	668 (58)	24,014	555	16,979	8,164 (458)	268,903
648 (24)	43,092	3,856 (63)	173,127	105 (4)	9,335	3,849 (93)	116,796	5,351 (149)	159,556	5,841 (57)	139,507	917 (63)	21,699	4,877 (288)	183,589	3,709	196,751	63,552 (1973)	2,311,282
—	—	+21 (+3)	+7,650	+153 (+2)	+10489	—	—	+1573 (+36)	+29654	+370 (+1)	+9,511	—	—	+562 (+5)	+6,816	−349	−6,765	—	—
—	—	−2 (−1)	−198	—	—	−71 (−1)	+2,342	−307 (−1)	−6,170	+14 (+1)	+535	−3 (−1)	−359	+717 (−9)	+17384	+1226	+16116	—	—

Figures in parentheses denote number of machines. * Not including machine tool cutting parts.

and Parts during May, 1958

Other Lathes		Milling Machines		Planing, Shaping and Slotting Machines		Presses and Sheet Metal-working Machines		Other Machines		Machine Tool Parts*		Total	
Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt.	Value £	Quantity. Cwt. and No.	Value £
184 (13)	12,545	2,101 (28)	84,675	35 (1)	1,254	2,270 (19)	67,120	3,900(113)	153,671	455	36,250	11,136(239)	465,487
—	—	—	—	—	—	833 (3)	12,291	25 (3)	853	70	2,211	928 (6)	15,355
—	—	255 (7)	12,257	—	—	—	—	93 (3)	5,154	66	5,900	419 (11)	23,643
(1)	17	628 (14)	37,126	9 (1)	656	1,194 (7)	34,834	45 (10)	7,674	214	28,024	3,548 (94)	216,680
—	—	210 (1)	12,796	93 (7)	14,613	—	—	822 (8)	122,313	1,220	138,267	5,479 (44)	538,773
—	—	584 (14)	18,426	629 (9)	9,990	285 (9)	13,622	611 (20)	20,223	1,471	32,812	4,892 (77)	156,191
184 (14)	12,562	3,778 (64)	165,280	766 (18)	26,513	4,582 (38)	127,867	5,496(157)	309,888	3,496	243,464	26,402(471)	1,416,129
—	—	—	−156	—	—	—	—	+4(+1)	+1,868	—	−70	—	—
—	—	—	—	—	—	—	—	—	—	—	+399	—	—
—	—	—	—	—	—	—	—	—	—	—	−9	—	—
—	—	—	—	—	—	—	—	—	—	—	−150	—	—
—	—	—	—	—	—	—	—	—	—	—	−602	—	—
—	—	—	—	—	—	—	—	—	—	—	+154	—	—

Figures in parentheses denote number of machines. * Not including machine tool cutting parts.

Machine Tool Share Market

After an initial setback, stock markets gradually developed a harder tone, and finished the period under review on a firm note.

The gilt-edged section remained quiet but steady for the most part, but became fairly active towards the close, and on balance higher levels were recorded for British Funds and similar fixed interest stocks.

Early dullness and irregularity in the commercial and industrial sections gave place to firm and generally cheerful conditions.

Final prices were about the best in most groups, and as values tended to improve, the volume of business increased.

Among machine tool issues, Asquith Machine Tool advanced 6d. at 20s.; British Oxygen, 6d. at 40s.; Broom & Wade, 6d. at 12s. 1½d.; Butler Machine Tool, 6d. at 7s.; Churchill Machine Tool, 3d. at 19s. 9d.; Geo. Cohen 3d. at 10s. 6d.; Export Tool, 3d. at 1s. 3d.; Alfred Herbert, 3d. at 36s. 6d.; Coventry Gauge & Tool, 1s. 10½d. at 16s.; Craven Bros. (Manchester), 9d. at 7s. 4½d.; and John Harper, 7½d. at 15s. 3d. On the other hand, Edgar Allen lost 3d. at 32s. 9d.; Clarkson Engineers, 3d. at 13s. 9d.; Samuel Osborn, 3d. at 19s. 9d.; and Birmingham Small Arms, 1s. to 31s. 6d.

Coming Events

INSTITUTION OF PRODUCTION ENGINEERS. *Wolverhampton Graduate Section.* September 17, at 7 p.m., at the Wolverhampton and Staffordshire College of Technology, Wulfruna Street, Wolverhampton; lecture on "Engineering Metrology," by J. R. Adams, B.Sc.(Eng.).

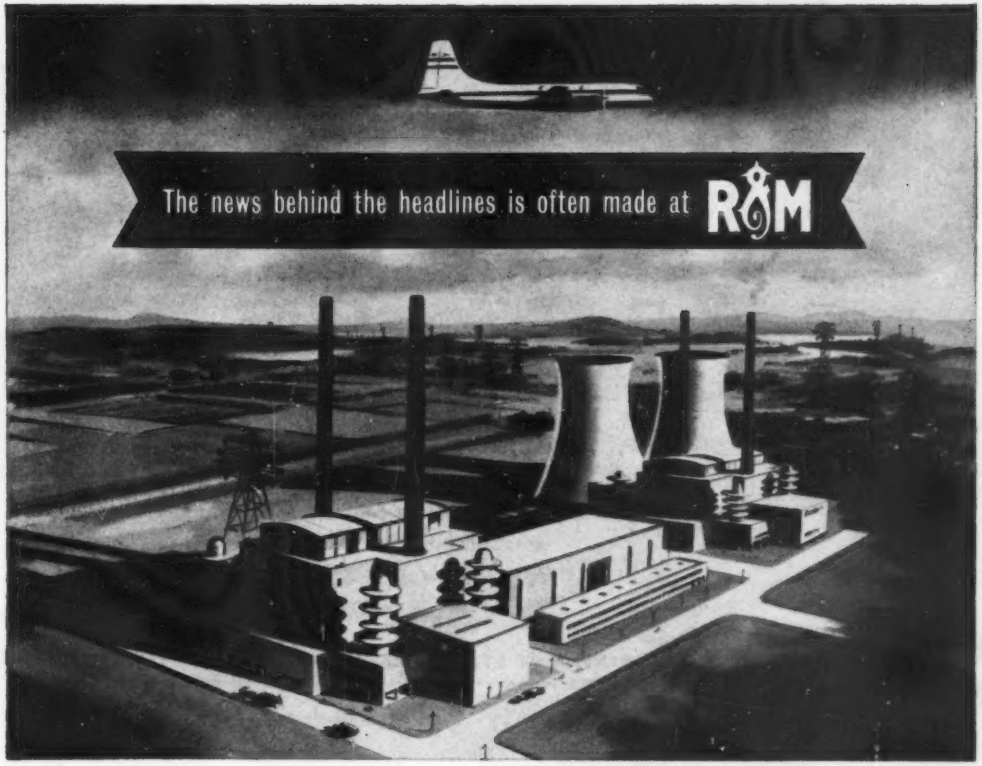
INSTITUTION OF MECHANICAL ENGINEERS. *Midland Branch.* September 18, at 6 p.m., at the James Watt Memorial Institute, Great Charles Street, Birmingham; paper on "Management Control of Small Engineering Firms," by L. Fontaine, W. R. Spencer and J. W. Walker.

Coventry Refrigerator/Target Merger

In the note published in MACHINERY 93/566—3/9/58, giving details of the merger between Coventry Refrigerator Co., Ltd., and Target Engineering Co., Ltd., one of the telephone numbers of the combined works at Northfield Road, Coventry, was stated incorrectly. The telephone numbers should have read Coventry 22256 and 22080.

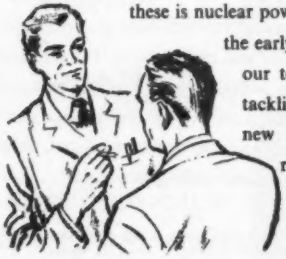
COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	32/9
" "	5% Prf.	£1	14/9*
Arnott & Harrison, Ltd.	Ord.	4/-	15/-
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	20/-
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	31/6
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	17/6
" " "	4% 1st Mort. Deb.	Stk.	87½
British Oxygen Co., Ltd.	Ord.	£1	40/-
" " "	6½% Cum. Prf.	£1	21/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	4/1½
Broom & Wade, Ltd.	Ord.	5/-	12/1½
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	14/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tools Co., Ltd.	Ord.	5/-	7/-
" "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	13/9
Churchill (Charles) & Co., Ltd.	Ord.	2/-	5/1½
" " "	6% Cum. Prf.	£1	26/3
Churchill Machine Tool Co., Ltd.	Ord.	5/-	19/9
" " "	6% Cum. Prf.	£1	18/6
Clarkson (Engrs.), Ltd.	Ord.	5/-	13/9
Cohen (George), Son & Co., Ltd.	Ord.	5/-	10/6xd
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	16/-
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	7/4½
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/3
" "	4½% Red. Cum. Prf.	£1	13/9
Expert Tool & Case Hardening Co., Ltd.	Ord.	1/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6
Greenwood & Batley, Ltd.	Ord.	£1	48/1½
Harper (John) & Co., Ltd.	Ord.	5/-	15/3
" "	4½% Red. Cum. Prf.	£1	13/1½
Herbert (Alfred), Ltd.	Ord.	£1	36/6
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	12/-
" "	"B" Ord.	5/-	11/6
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	23/-xd
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	45/-
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/7½
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	8/9
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	8/3
Modern Engineering Machine Tools Ltd.	Ord.	5/-	10/7½
Newall Engineering Co., Ltd.	Ord.	2/-	4/9
Newman Industries, Ltd.	Ord.	2/-	2/3
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	19/9
" " "	5½% Cum. Prf.	£1	25/9
Pratt (F.) & Co., Ltd.	Ord.	5/-	21/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/-
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	38/-
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	12/9
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	11/9
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	6/3
Tap & Die Corporation, Ltd.	Ord.	5/-	8/-
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	17/6
Ward (Thos.) W.), Ltd.	Ord.	£1	80/-
" "	5% Cum. 1st Prf.	£1	15/6
" "	5% Cum. 2nd Prf.	£1	24/-
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.



Have Ransome and Marles been associated with any of the big developments in British industry?

We don't hit the headlines — but we often help to make headline news possible. Since the war we have carried out research into design, materials, lubrication and production for a number of important projects. One of these is nuclear power generation. From the early days of Calder Hall our technicians have been tackling fresh problems as new and more powerful reactors are designed.



Are there any other interesting projects?

Yes, several. Britain has been achieving a world-wide success with her aircraft engines. Two notable users of R&M Bearings are Armstrong-Siddeley Motors and Bristol Aero Engines. The Proteus engines of the latest Bristol Britannia are of course fitted with R&M Bearings.

Then again "automation" is a popular word these days. We at R&M are becoming increasingly "automatic" in many of our processes in shops and offices. We also supply the bearings for the latest electronic machines. Our customers include Powers Samas, Elliott Brothers, IBM and British Tabulating Machines — just another example of the role played by R&M in all fields of industrial development.

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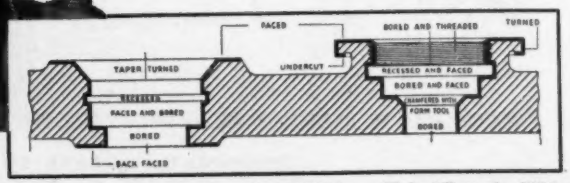

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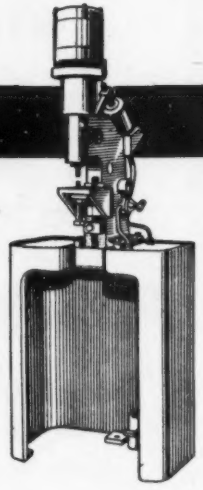

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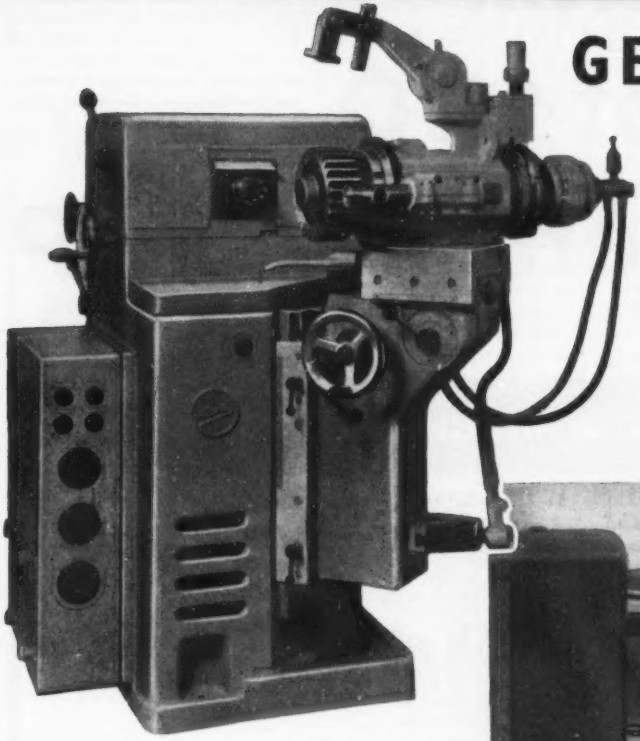

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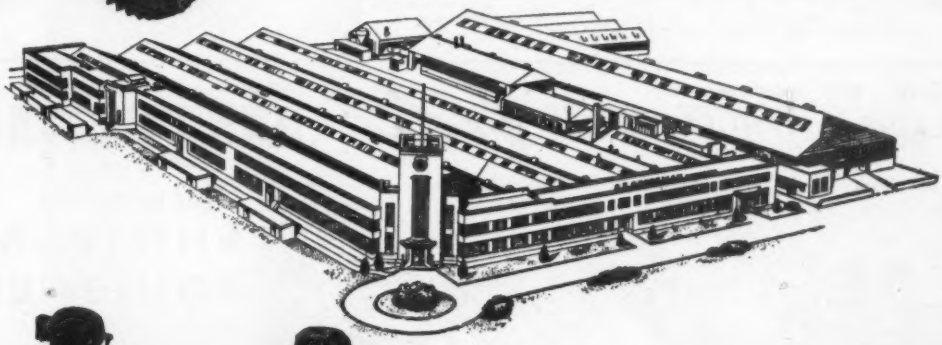

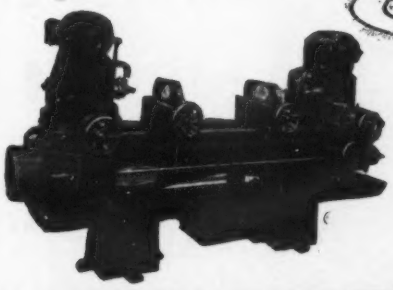

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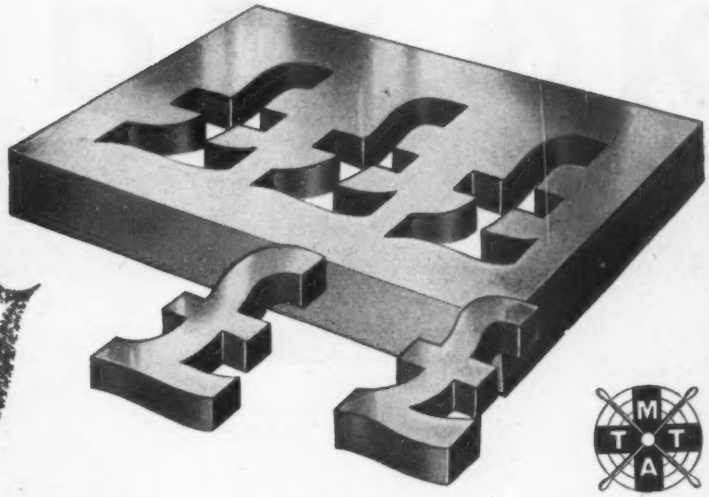

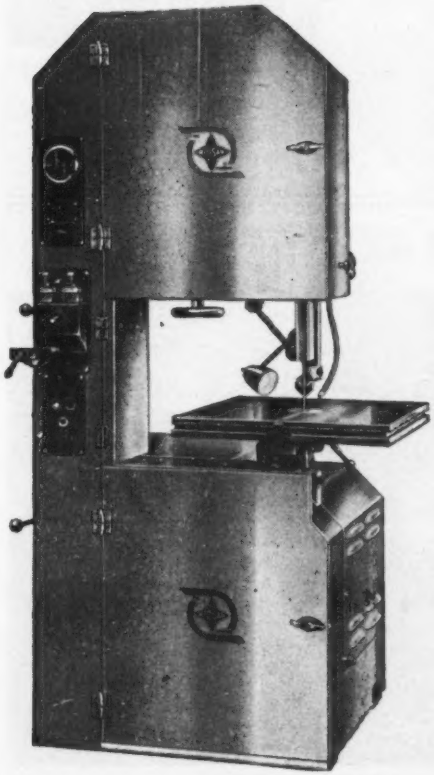

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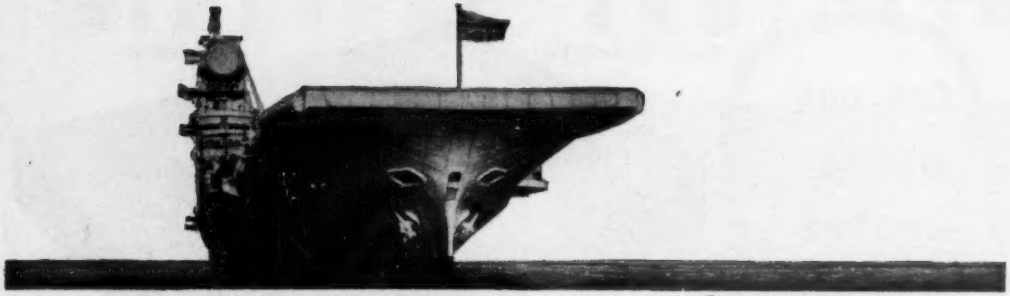

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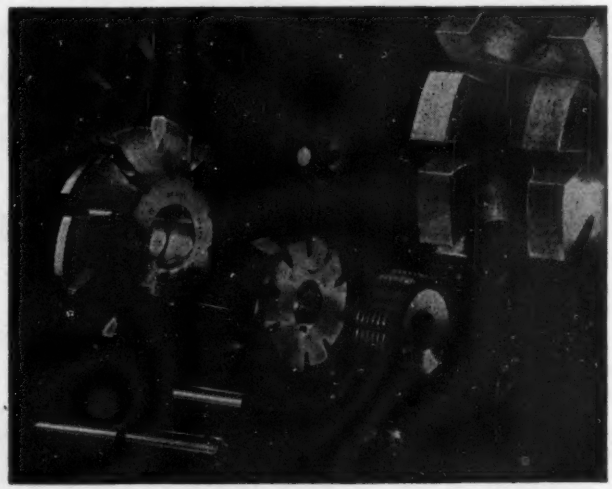

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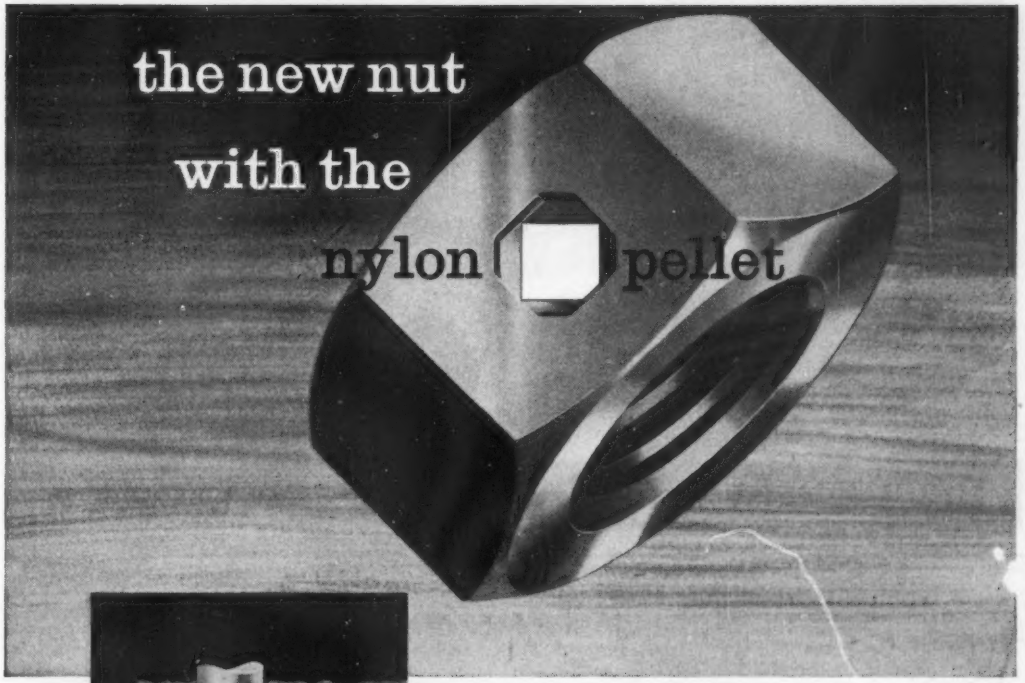

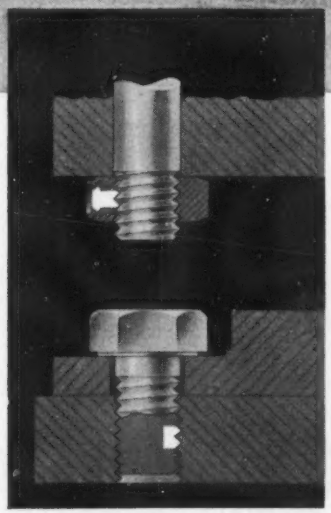

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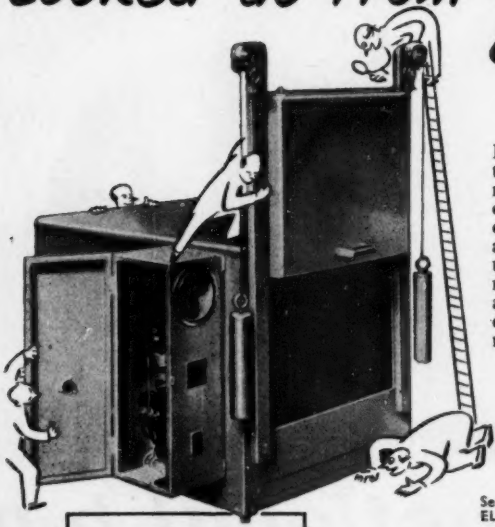

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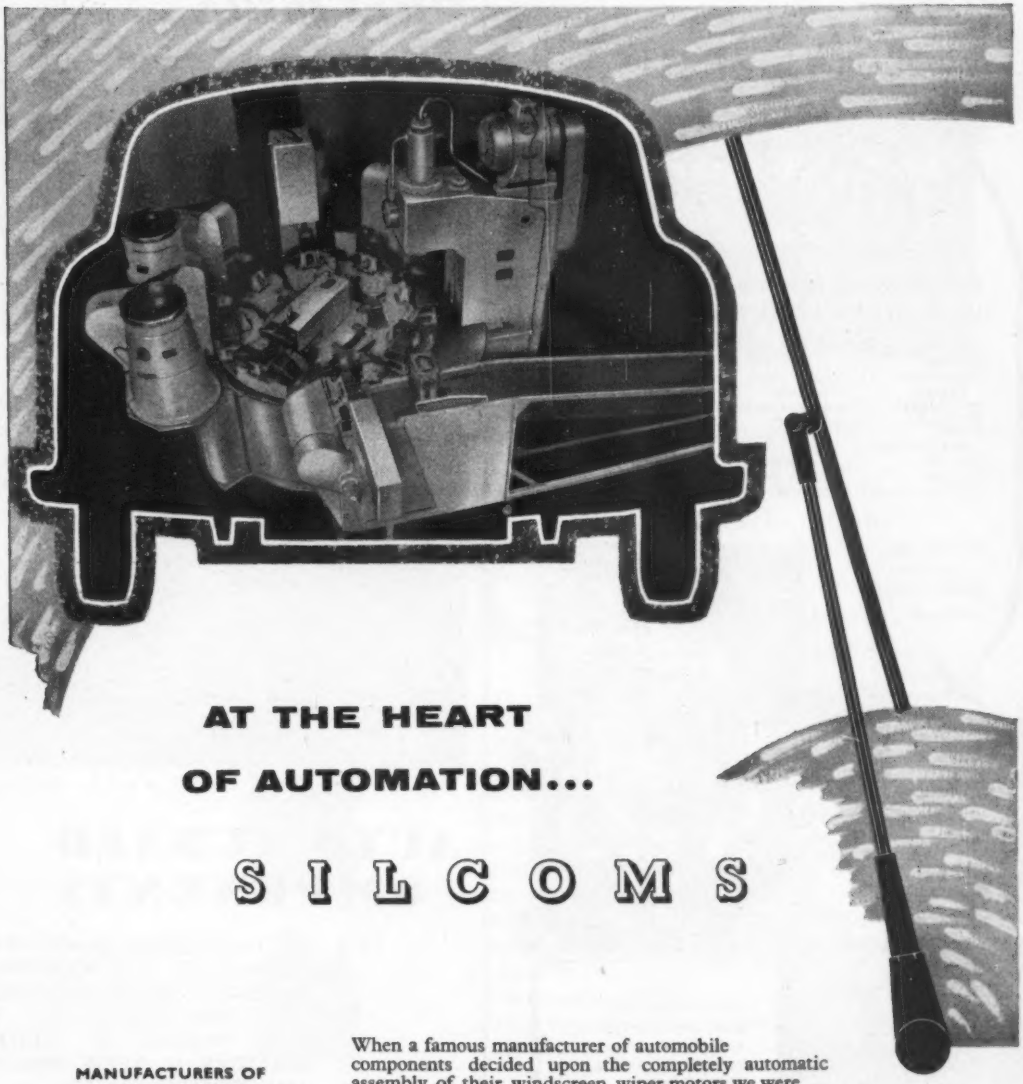

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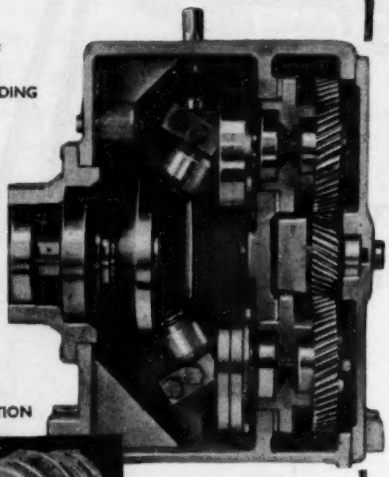

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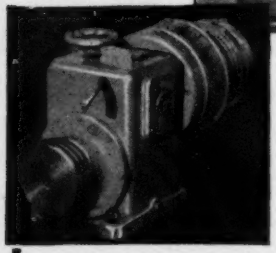

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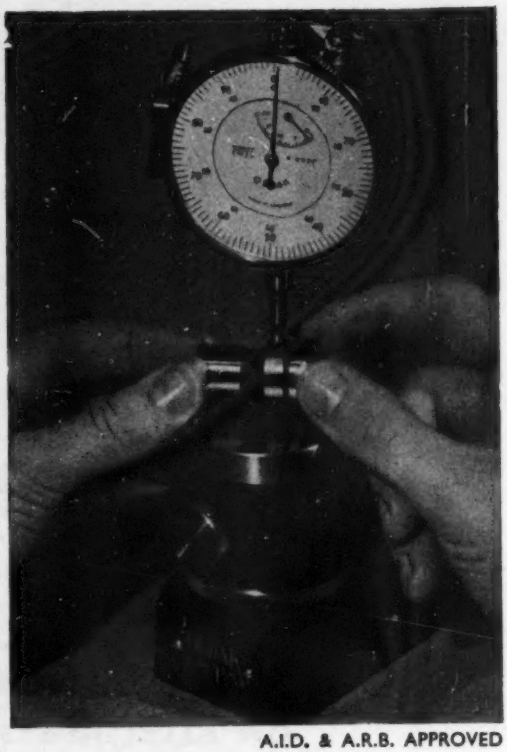

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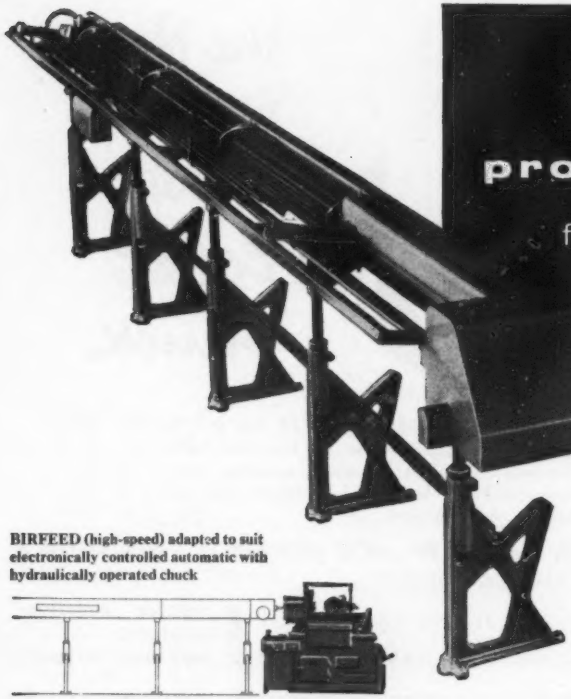

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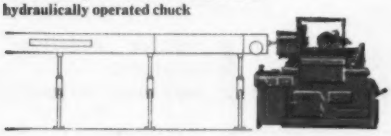
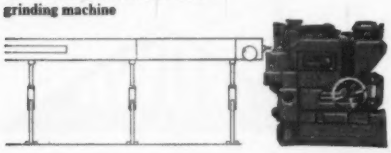
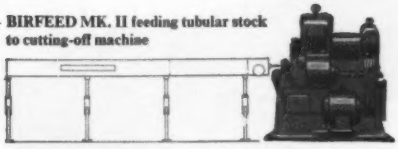


BIRFEED attached to centreless grinding machine



BIRFEED MK. II feeding tubular stock to cutting-off machine



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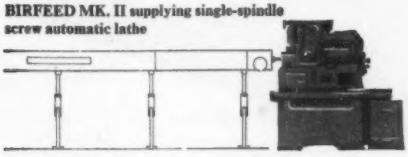
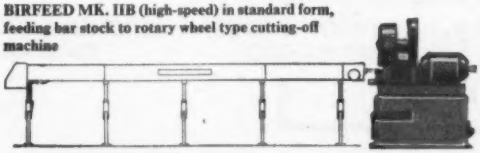


BIRFEED MK. IIB (high-speed) in standard form, feeding bar stock to rotary wheel type cutting-off machine



The BIRFEED Automatic Magazine Bar-feeding Attachment is readily installed: there is only one small modification necessary to the existing mechanism of a bar-fed machine tool. The BIRFEED is adjustable to the centre height of any machine. Standard BIRFEED attachments have been designed to suit the majority of modern capstan lathes, single-spindle screws, automatic lathes, and parting-off machines, but there are numerous other adaptations available to suit this outstanding equipment. Details of the BIRFEED models, including optional extras and adaptations will be forwarded on request.

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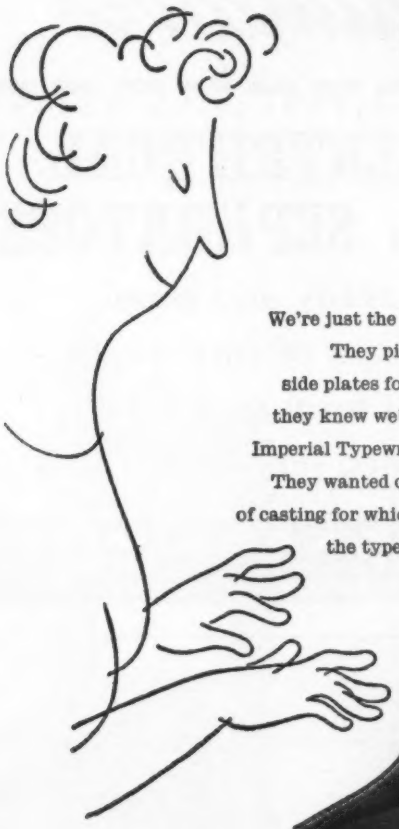

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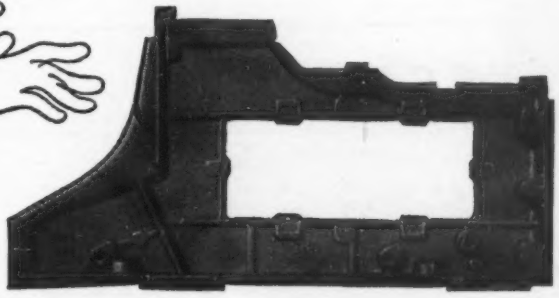

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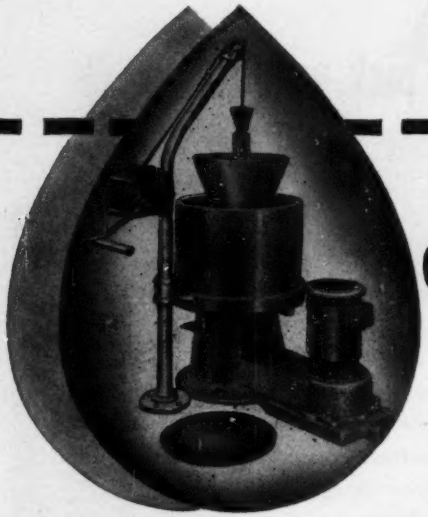

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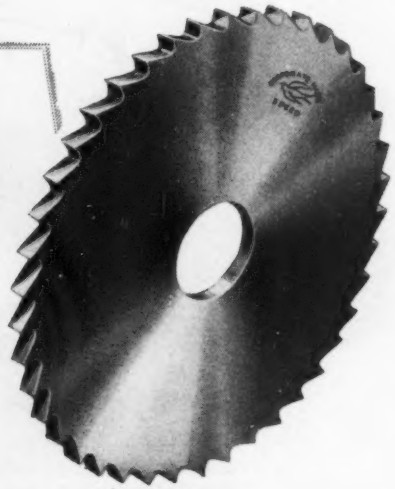

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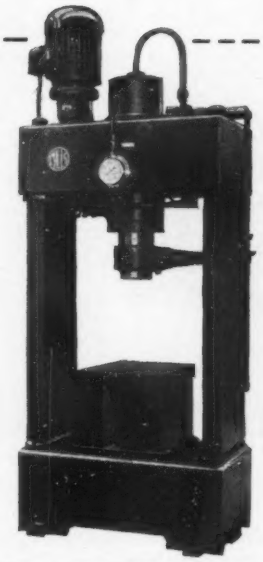

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Stroke fully adjustable over whole ram travel.
Hand lever operation—ram returns automatically when released.
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Removable footstock.
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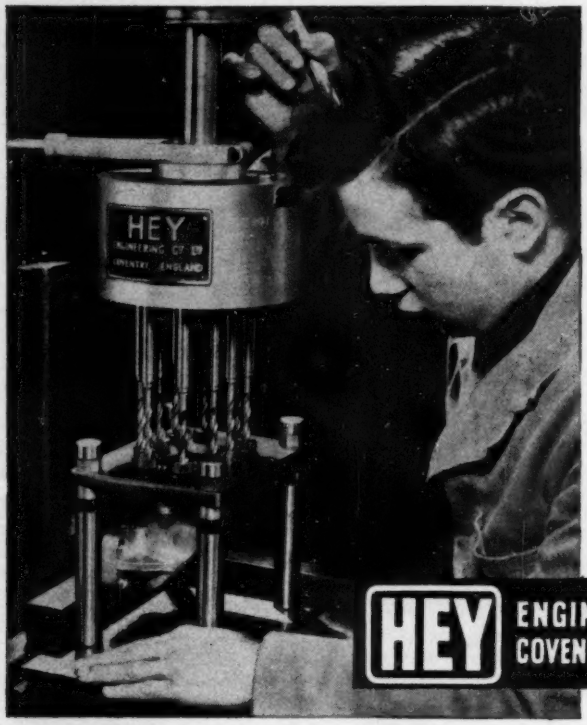

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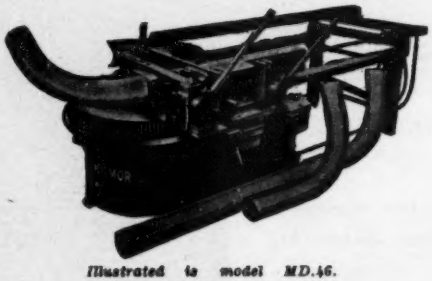

Illustrated is model MD.46. Produces full bore bends unfilled on short radii up to 6in. dia. non-ferrous tube and 4in. dia. light gauge ferrous tube.

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★ Hand and Power operated general purpose machines to bend up to 5in. diameter light gauge tube.

★ Hand operated and motorised Mandrel machines to produce uniformly accurate full bore bends on extra short radii, cold and without filling.

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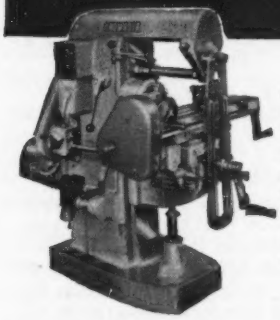

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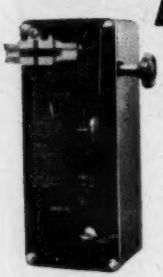

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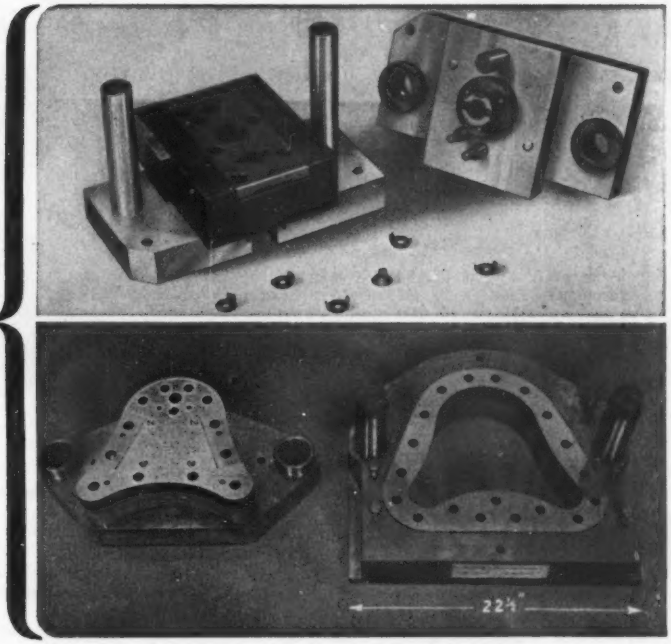

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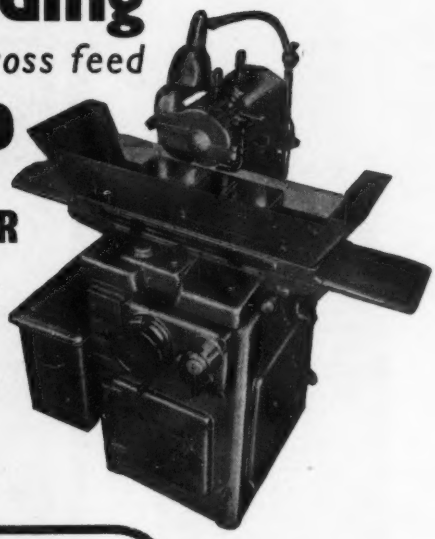

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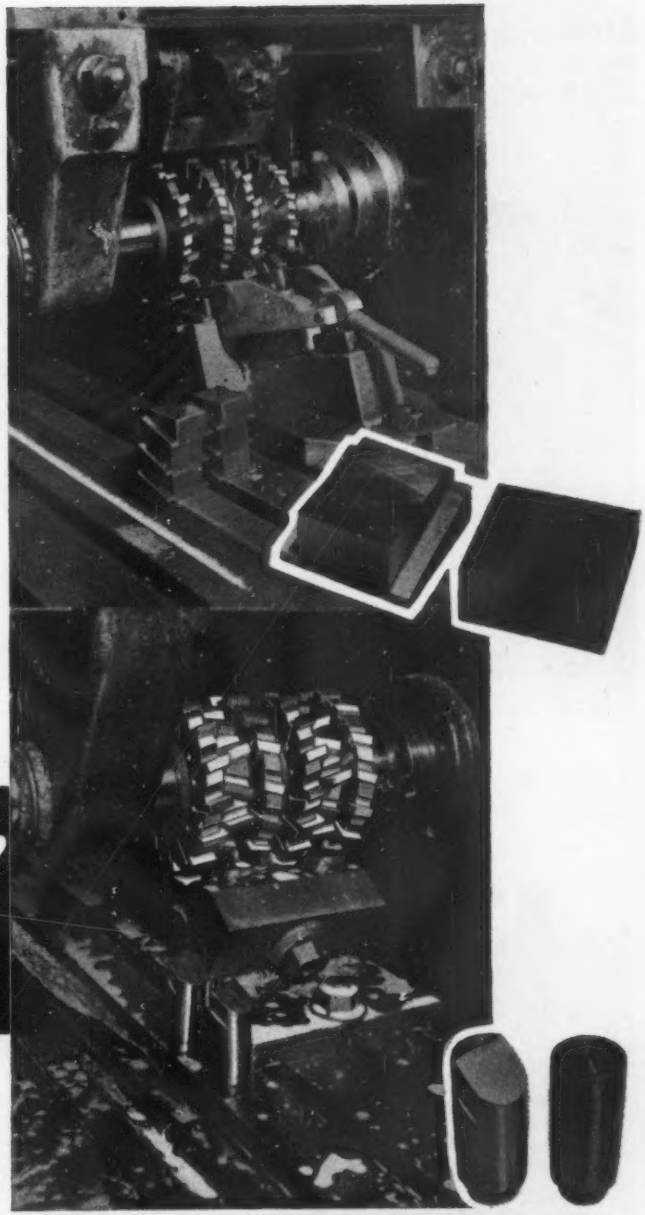

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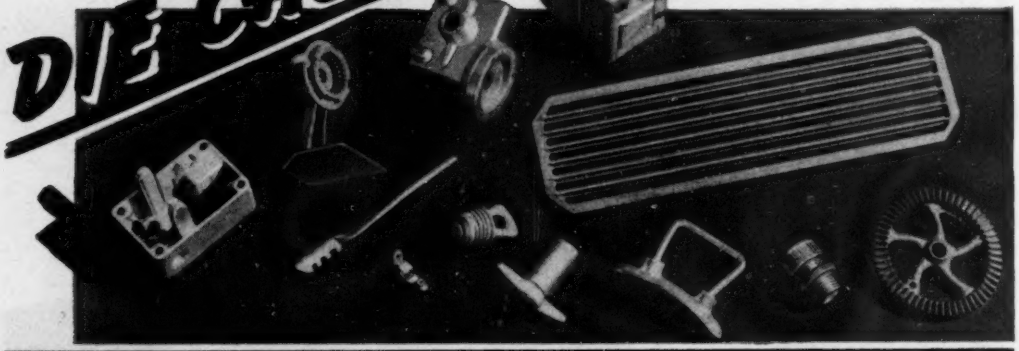

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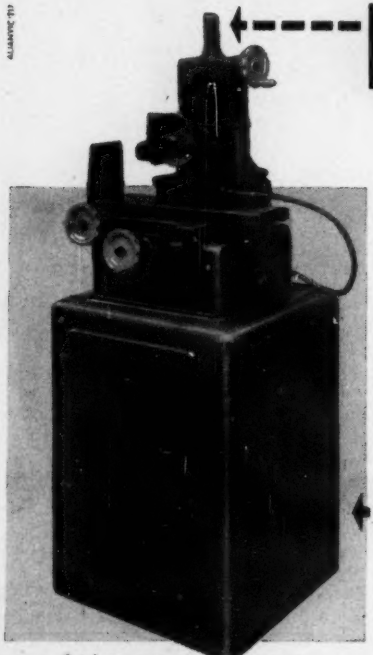

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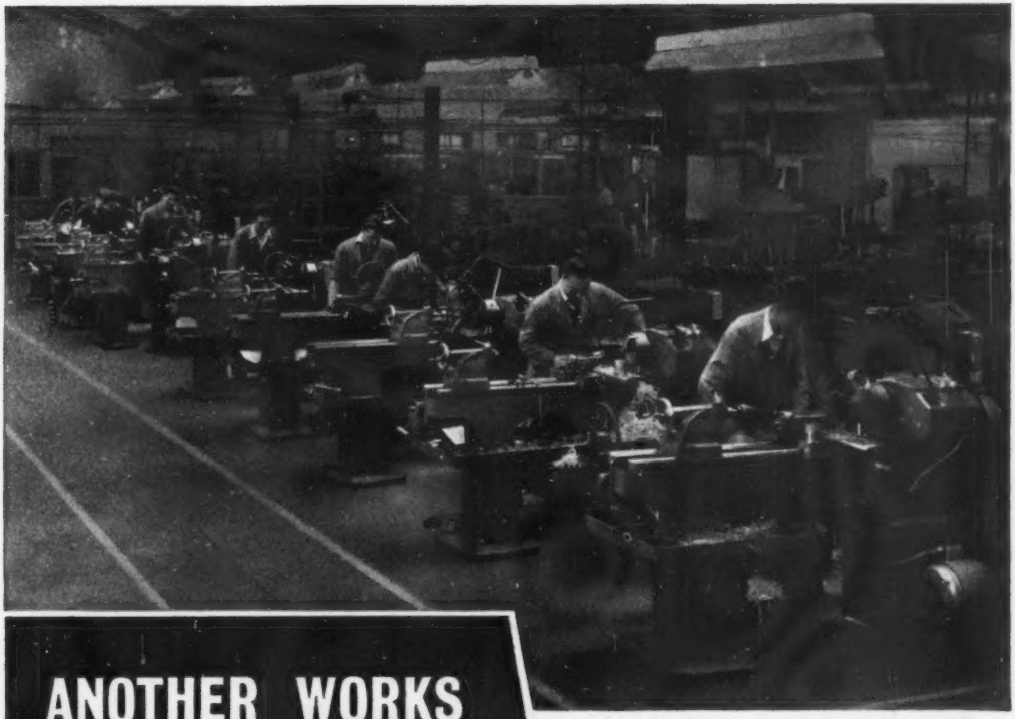

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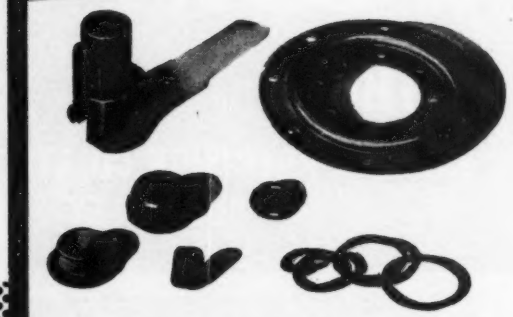

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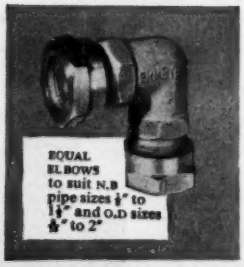
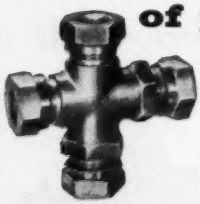
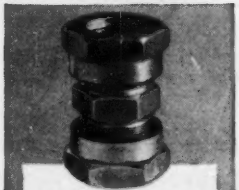



EQUAL CROSSES to suit O.D pipe sizes ⅜" to 2" and N.B pipe sizes ¼" to 1¼"

BANJO COUPLINGS to suit O.D pipe sizes ⅜" to 2" and N.B pipe sizes ¼" to 1¼"


STRAIGHT COUPLINGS to suit N.B pipe sizes ¼" to 1¼" and O.D sizes ⅜" to 2"

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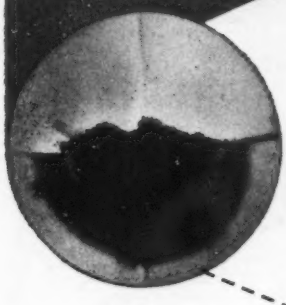
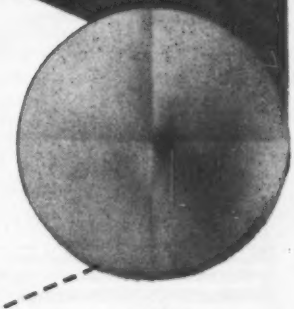


BEFORE
Solids present in coolant



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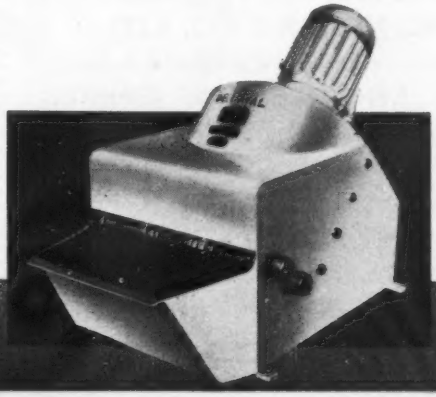

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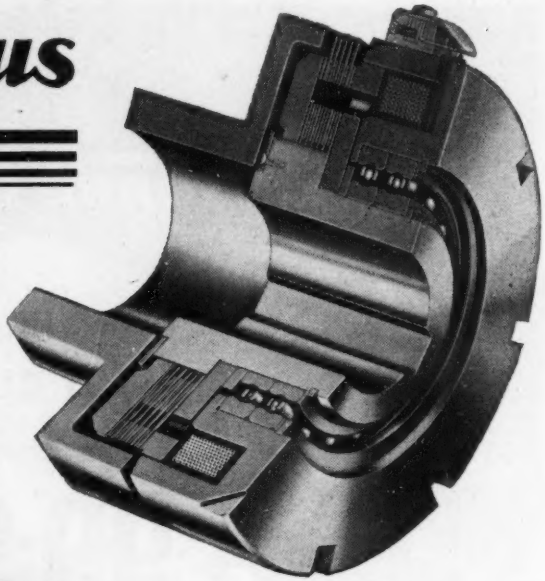

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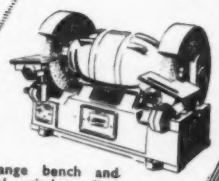

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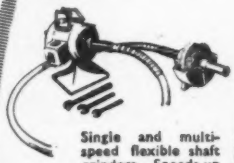

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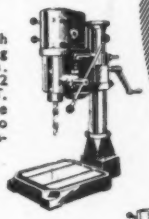

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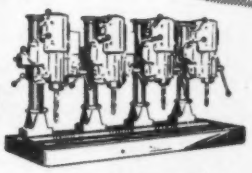

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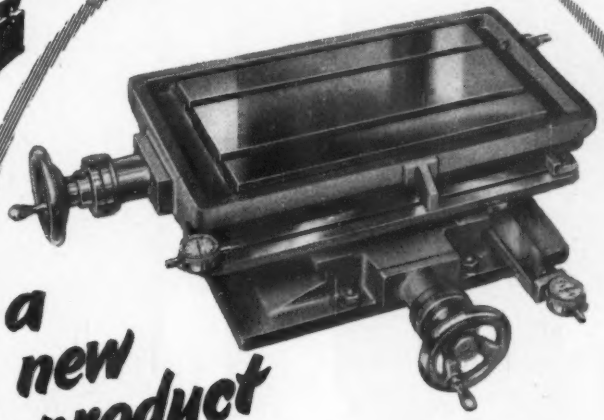

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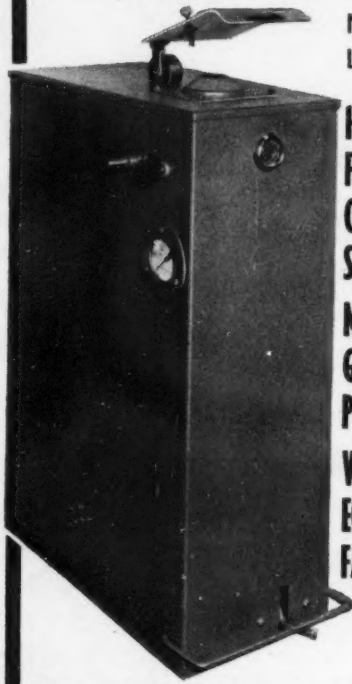

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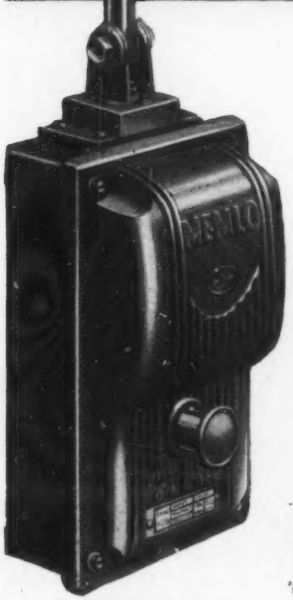

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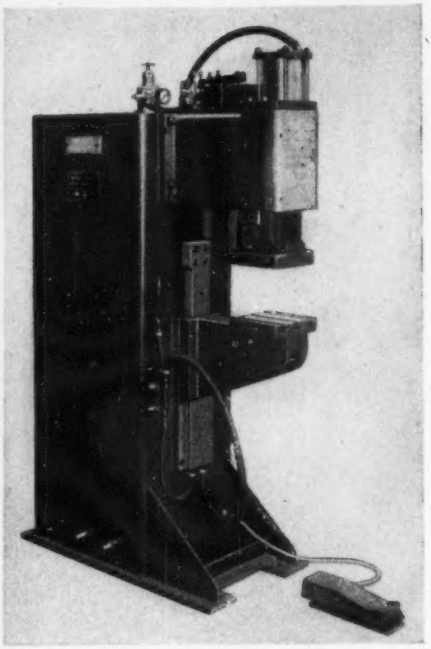

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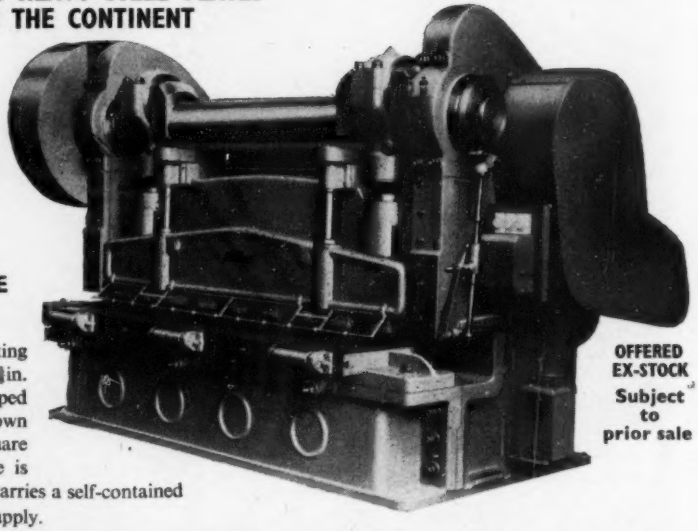

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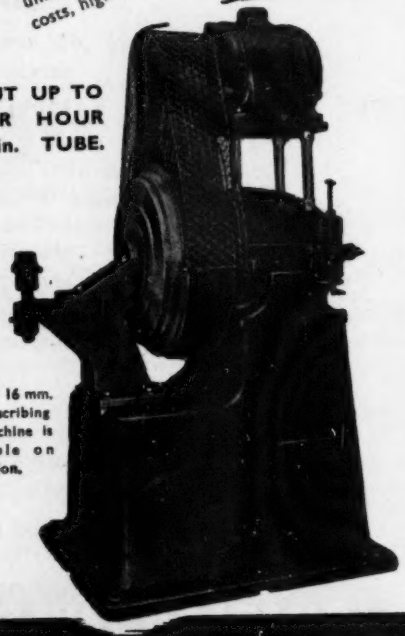

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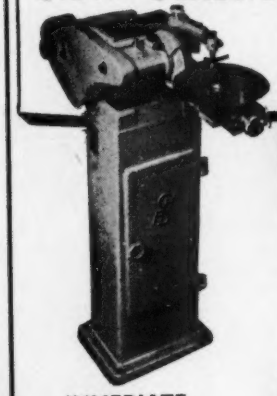

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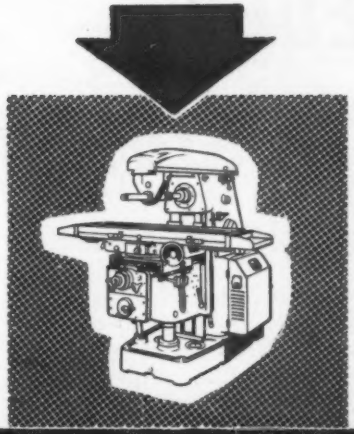

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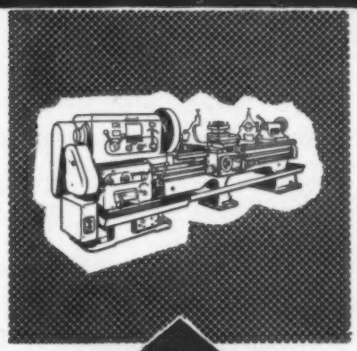

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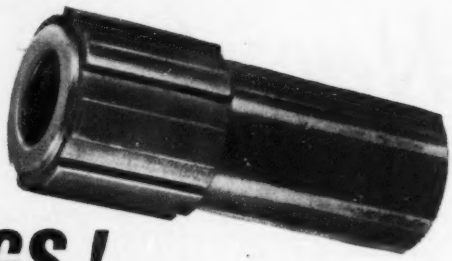

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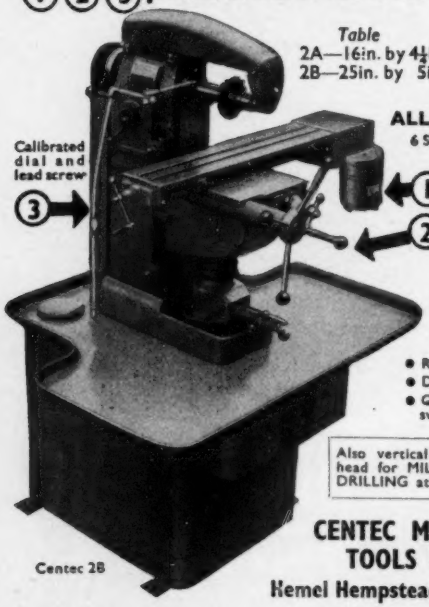
① ② ③ possibilities of table movement



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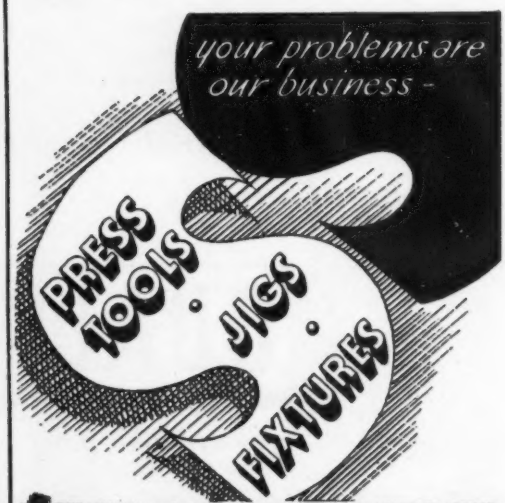

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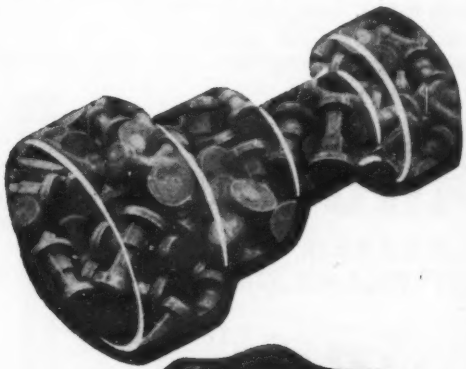

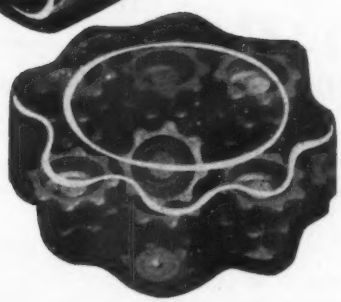

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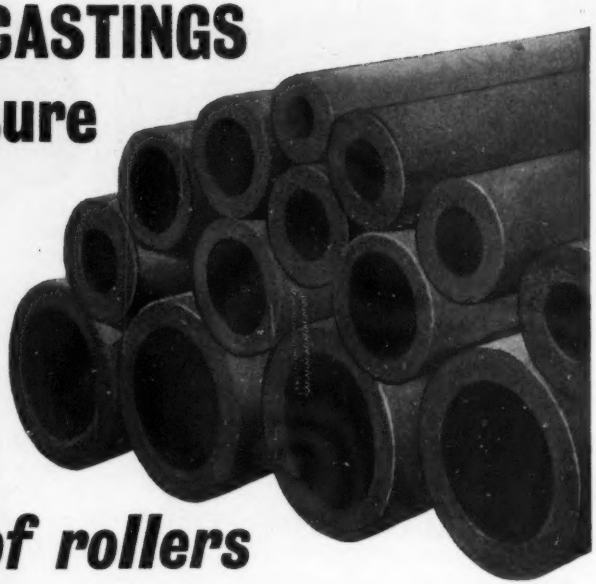

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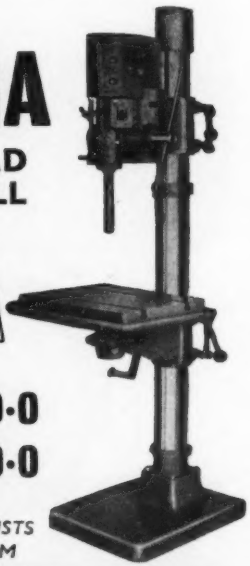

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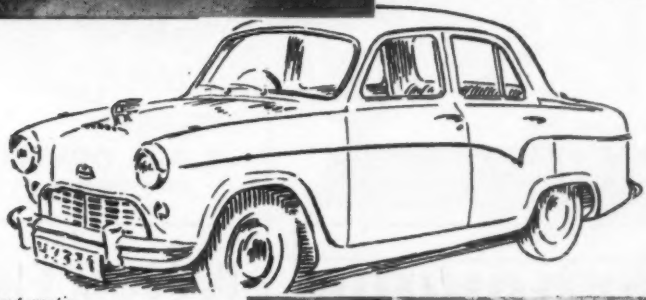

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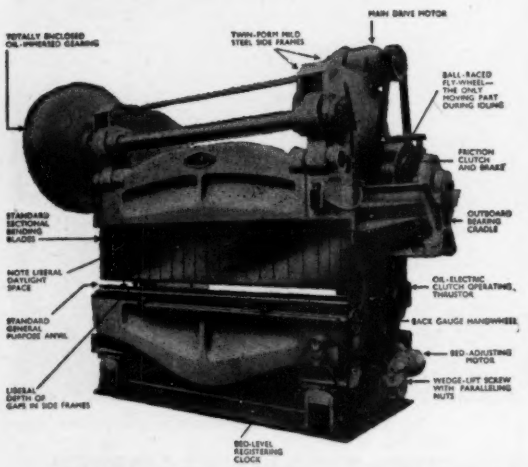

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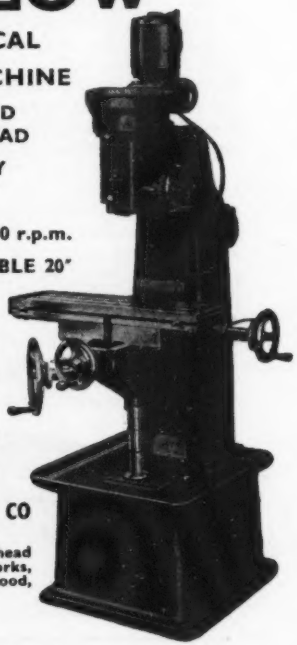

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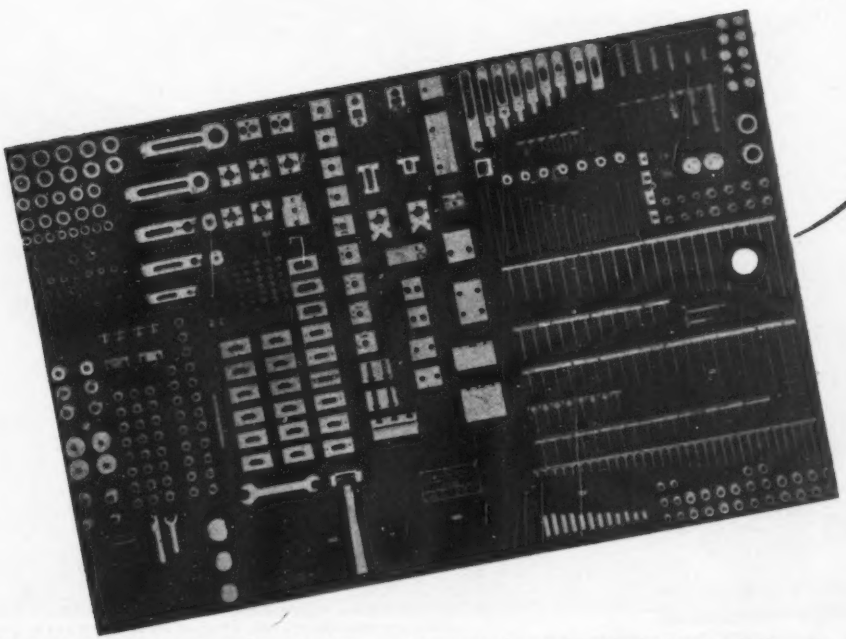

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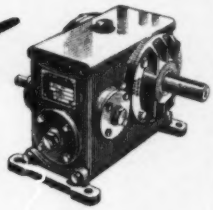

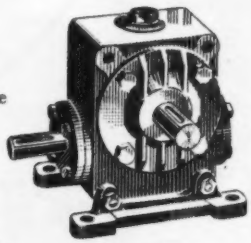

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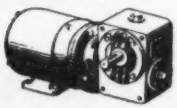

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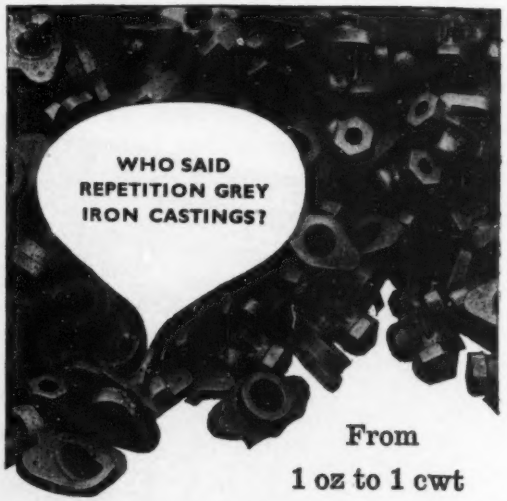

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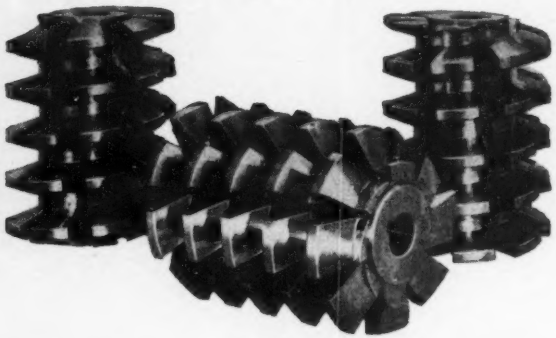

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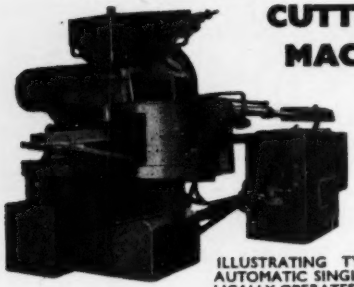

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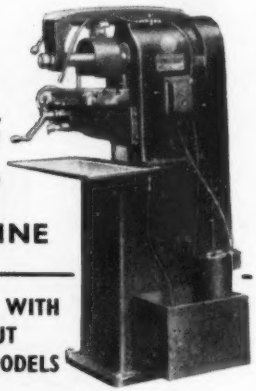

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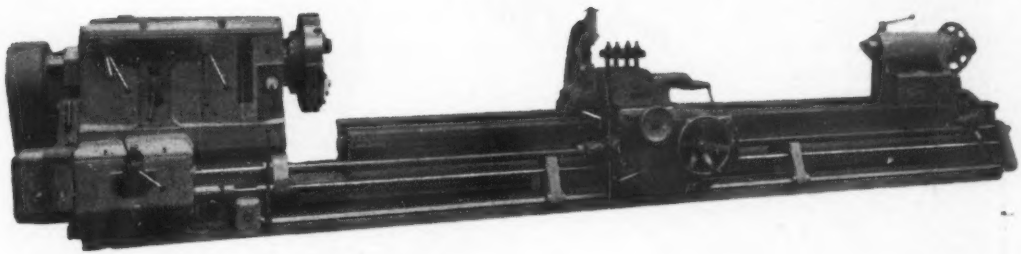

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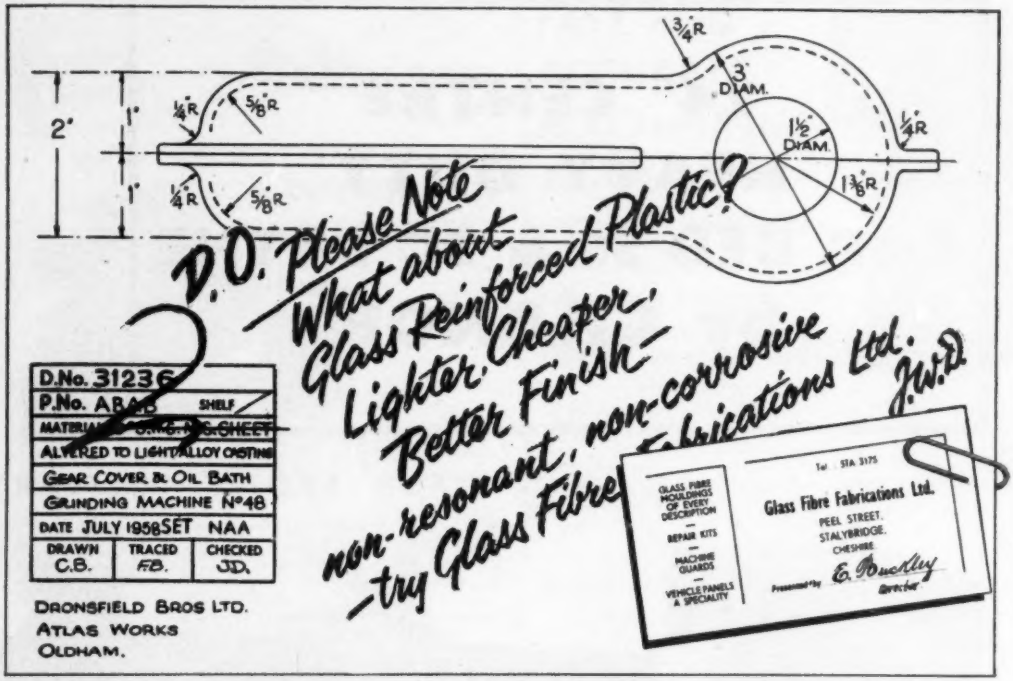

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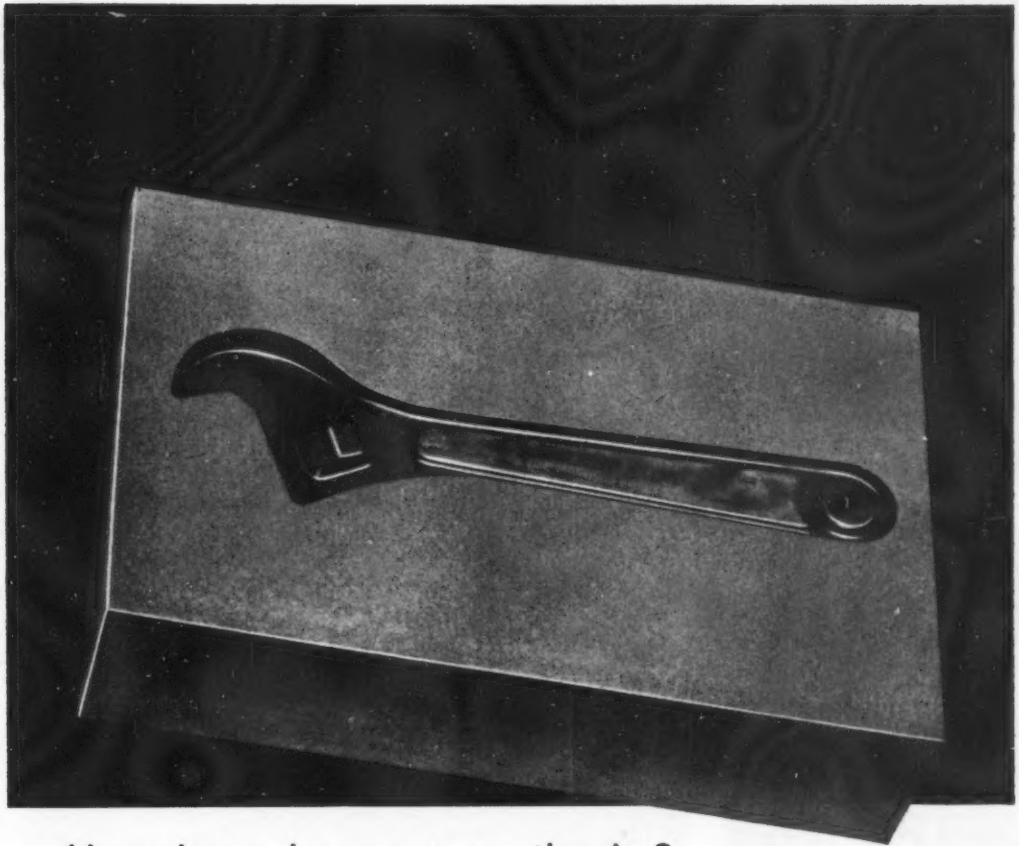

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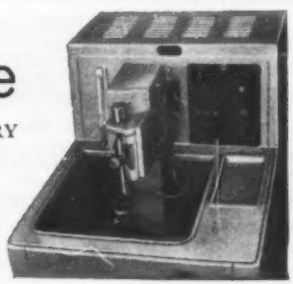

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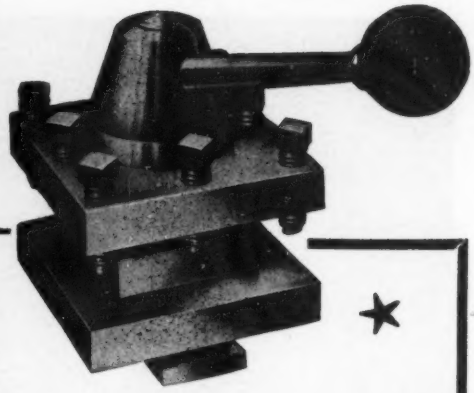

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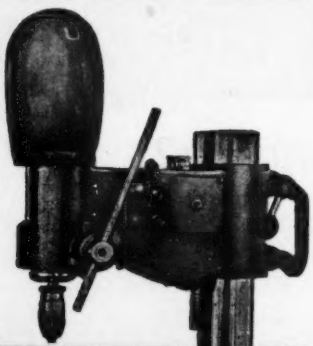

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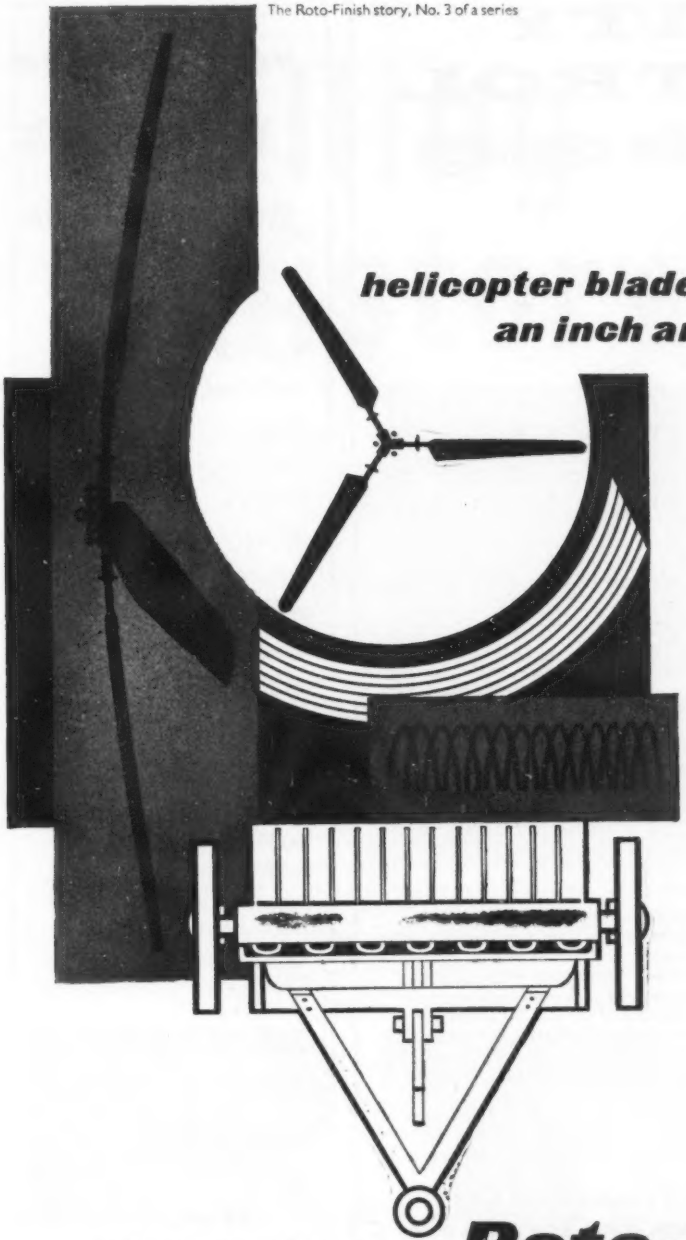

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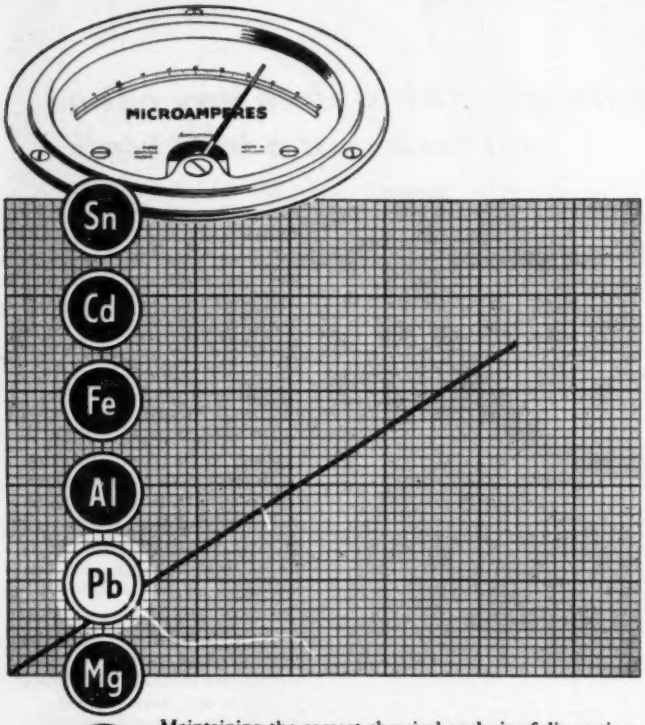

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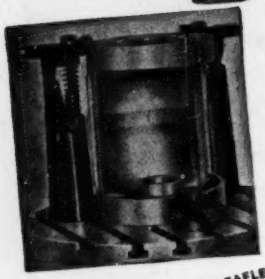

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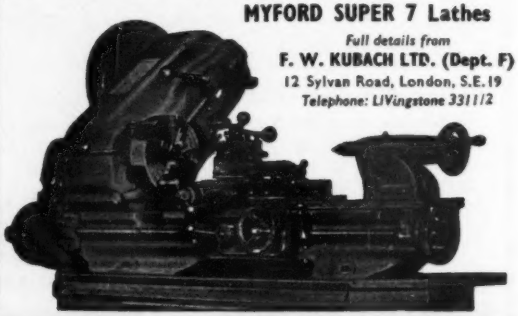

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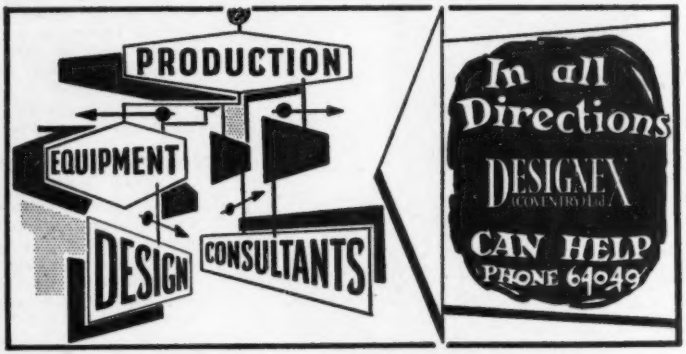

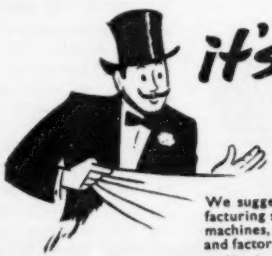

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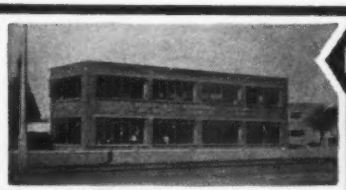
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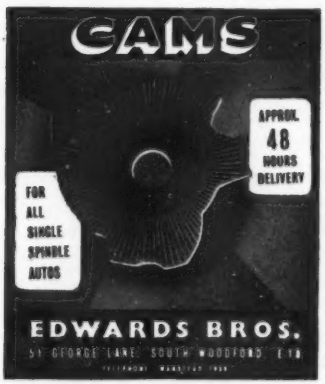

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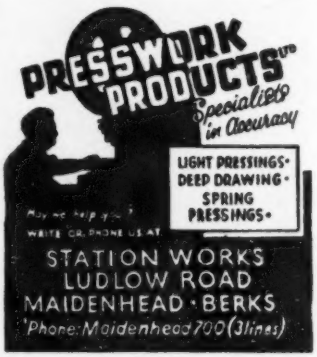

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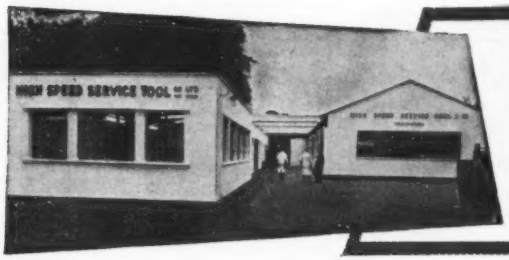

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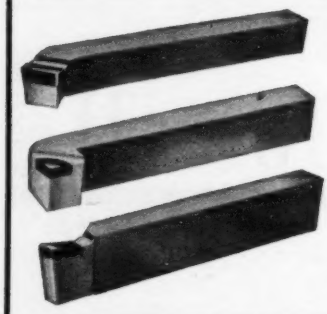

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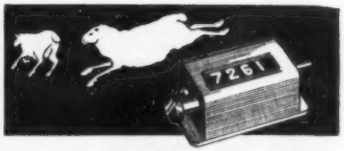

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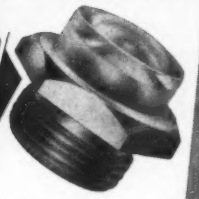

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CHURCHILL 42in. Ring Grinder.
SCRIVENER 2C Centreless Grinder.
HENDEY 24in. × 168in. S.S. & S.C. Lathe. Speed Range 14-560 r.p.m.
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OLDFIELD & SCHOFIELD 12½in. × 7ft. S.S. & S.C. Lathe. Gap Bed. Speed Range 12-400 r.p.m.
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TOWN 3ft. No. 3 M.T. Radial Drilling Machine. Speed Range 126-1,450 r.p.m.
ARCHDALE 4 No. 4 M.T. Radial Drilling Machine. Speed Range 80-2,000 r.p.m.
ARCHDALE 3ft' No. 2 M.T. Radial Drilling Machine. Speed Range 126-1,440 r.p.m.
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Modern Machines—Motorised 400-440/3/50. Fully Overhauled—Six months' Guarantee.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

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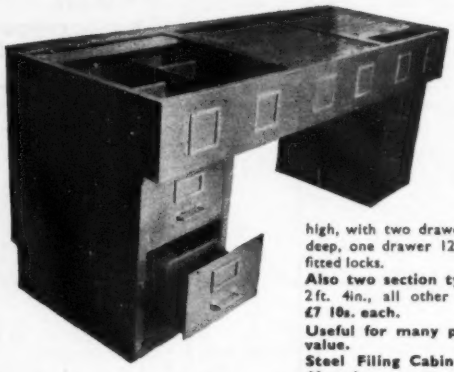

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horizontal Roller Shutters. Top portion 6ft. 6in. by 2ft.4in. by 9in. deep, three sections with RollerShutters,fitted locks, each section two divisions, 12in. wide by 7in. deep mounted on two pedestals 2ft. 0in. by 1ft. 4in. by 2ft. 0in. high, with two drawers 12in. wide by 7½in. deep, one drawer 12in. wide by 4in. deep fitted locks. **£10 each.**

Also two section types, size 4ft. 4in. by 2ft. 4in., all other dimensions as above, **£7 10s. each.**

Useful for many purposes, marvellous value.

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Scriven 3-Roll Plate Bending Machine, rollers 14ft. wide, ¼in. capacity.

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Feeds ·005/·020
Speeds 5·6/125 RPM.
Murray Colour control system.
4 jaw chuck.
Excellent condition.
Immediately available.

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ESSEX 22	...	**£83 10s.**
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Cashmores

Selection of Machine Tools from Stock

CENTRE LATHES

LANG 3½in. S.S. & S.C. Lathe to admit 4ft. 0in. between centres.
COLCHESTER MASCOT 6½in. S.S. & S.C. Lathe, to admit 4ft. 6in. between centres.
New **MITCHELL OF KEIGHLEY** 12½in. S.S. & S.C. Lathe, to admit 8ft. 9in. between centres.
VOLMAN 8in. S.S. & S.C. Gap Bed Lathe, to admit 4ft. 6in. between centres.
New **MITCHELL OF KEIGHLEY** 10½in. S.S. & S.C. Lathe, to admit 7ft. 5in. between centres.
F.L.C.E. 13in. S.S. & S.C. Heavy Duty Lathe, to admit 17ft. between centres, 2 saddles.

CAPSTAN LATHES

WARD 3A Capstan Lathe, with collet chuck and bar feed, 1½in. capacity.
WARD No. 7 Capstan Lathe, with covered bed, arranged for chuck work, 2½in. hollow spindle.
WARD 2A Capstan Lathe, with collet chuck and bar feed, 1½in. capacity.

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TULLIS Horizontal Boring Machine, Floor Type with 3½in. traversing spindle, 9ft. 0in. by 2ft. 6in. tee-slotted baseplate.

UNIVERSAL GRINDING MACHINE

LANDIS 16in. by 36in. Universal Grinding Machine, with hydraulic feed

DRILLING MACHINE

GIRARD 5ft. 0in. Radial Drilling Machine. Elevating Arm, with Loose Box Bed. Two-motor type.

PLAIN GRINDING MACHINE

CHURCHILL 10in. by 36in. Hydraulic Plain Cylindrical Grinding Machine.

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HERBERT 23V Vertical Milling Machine. 68in. by 17in. table.
CINCINNATI No. 3 Dial Type Vertical Milling Machine, 62½in. by 15in. table, motorised.
ARCHDALE 18in. Vertical Milling Machine, 38in. by 10in. table.
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EDGWICK 18in. Production Milling Machine, working surface of table 26in. by 12in.
New **VICTORIA** U1, U2 and U3 Universal Milling Machines.
ARCHDALE 20in. Horizontal Plain Milling Machine, 40in. by 10in. table.
CUTTAT HYPERMIL Production Milling Machine, 43in. by 10in. working surface of table, with 4 automatic cycles to table.

SAWING MACHINES

RUSSELL 20/24in. Cold Circular Sawing Machine, with hydraulic clamping to vice.
NOBLE & LUND 11/16in. Cold Circular Sawing Machine.

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Selection of Machine Tools from Stock or Early Delivery.

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LATHES

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New **MITCHELL** 12in. Centre Gap Bed Lathe, admit 8ft. 9in. between centres, motorised 400/3/50 cycles.
HOLBROOK Model B Type No. 17 S.S. & S.C. Lathe, swing over bed 18¼in. dia., admit 42in. between centres, range of spindle speeds 10-525 r.p.m., motorised 400/3/50 cycles.
New **MITCHELL** 10½in. Lathe, 7ft. 5in. between centres, motorised 400/3/50 cycles.
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WARD No. 2A Capstan Lathe, power feed to saddle and turret, ball chuck and bar feed, motorised 400/3/50 cycles.
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REINECKER 21in. by 66in. Hydraulic Plain Grinder, motorised 400/3/50 cycles.
ORCUTT 20in. Hydraulic Spline Shaft Grinder, motorised 400/3/50 cycles.

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BOHLE Heavy Duty Universal Miller, table 55in. by 14in., motorised 400/3/50 cycles.

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MISCELLANEOUS

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MISCELLANEOUS.

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BURKE. Table 16 × 3½.
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CINCINNATI 3-24 Hyd.
HERBERT 1S. Table 18in. by 8½in.

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VICTORIA V2. Table 40 × 10.
ARCHDALE 30in. Table 48 × 12½.
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O. & S. 30 tons straightening.
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ROTORIVET No. 5 Hammer.
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JONES No. 26. 2 B.A.-⅝in.
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QUICKWORK No. 321 Motorised Rotary Shearing Machine with circle cutting attachment. Arranged motor drive 400-440/3/50. Capacity mild steel 14 s.w.g. Cuts circles from 6in. to 60in. diameter. Depth of shear throat 30in.

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Photographs of the above are available.

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MITCHELL OF KEIGHLEY 12¼in. Gap Bed Lathe by 6ft. 9in. b.c. 400-440/3/50

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NEWALL Hydraulic "XL" 6in. by 18in. Plain Grinding Machine. 400-440/3/50.

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WARD 2A, A.G.H., bar feed, motorised.

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G. & L. "Grand Rapids" No. 25 Hori. Spindle Surface Grinder. £275.

Weisser 6¼in. Lathe. A.G.H. £275.

Corona 2AX No. 2 M.T. Drilling Machine. £67 10s. 0d.

Speedax No. 2 Riveter. £35.

Jos. Heap 1in. Tangential Screwing Machine. £165.

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Herbert 2D Capstan. Bar feed, 1¼in. capacity collet machine. £350.

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Murad 3Q Capstan, ¾in. Cap. Self-contained, motorised, cabinet type, £75.—C. L. THOMAS, LTD., 18, Park Avenue, Solihull 1281.

Bryant No. 4 Internal Chucking Grinder. Capacity ⅛-2in. bore. Max. swing 6¼in. Mot.—WILCOX & CO., Barr Street, Birmingham, 19. NORthern 1234/5.

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R. Ruhemann

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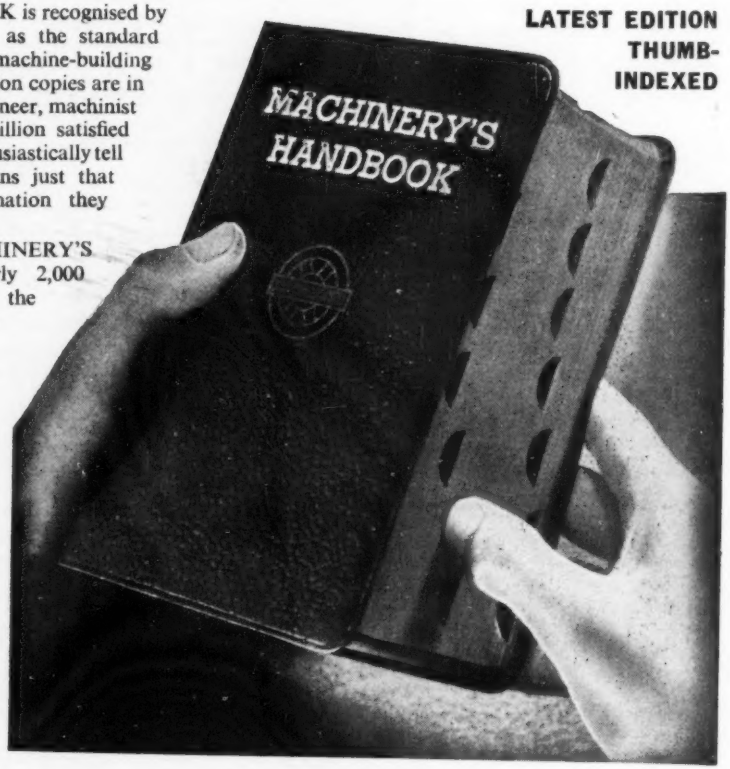

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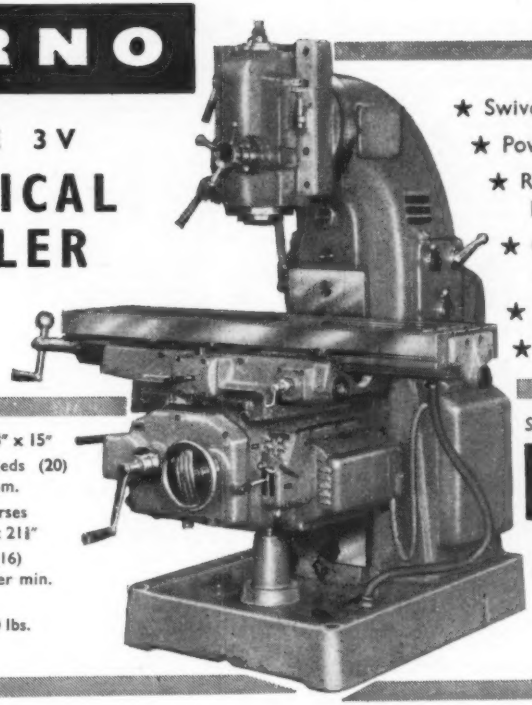

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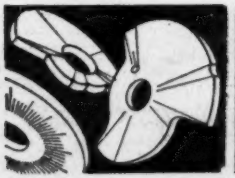

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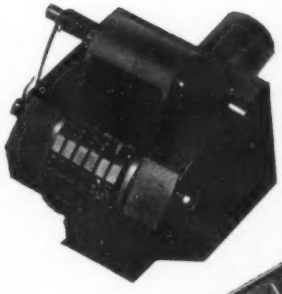

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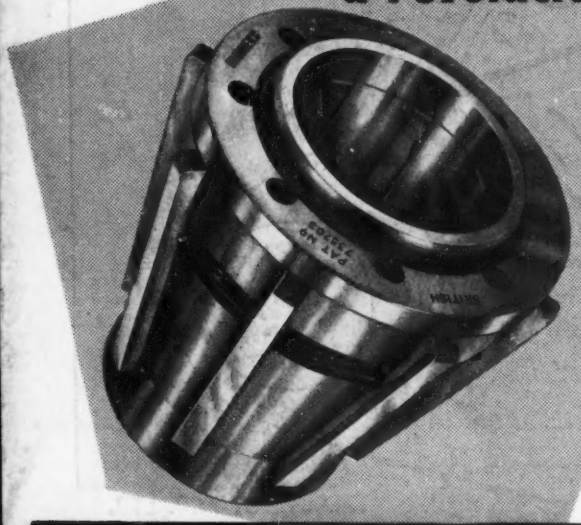
BURNERD PRECISION "multisize collet"

a revolutionary NEW workholder

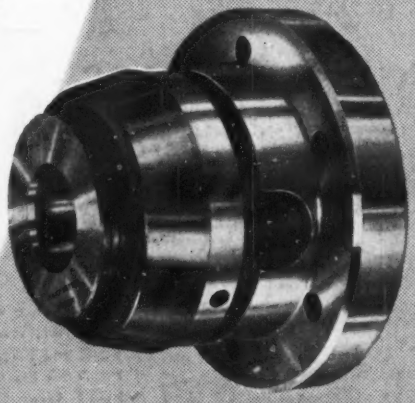


SUPERLATIVE ACCURACY · GRIP · RIGIDITY

TEN FEATURES OF THE COLLET

- Powerful grip—MANY TIMES GREATER THAN SPRING COLLETS.
- Greater accuracy than ever before achieved with collets.
- Grips and locates without distortion of collet.
- Each collet covers $\frac{1}{8}$" range of capacity.
- Only eleven collets required to hold any diameter bar between $\frac{1}{8}$" and $1\frac{1}{2}$" whether English, metric or decimal sizes.
- Positive grip maintained under load.
- No difficulty with under and oversize components.
- Maximum feeds and speeds obtainable without risk of slipping and scoring or distortion of components.
- Constant parallel grip throughout complete range of collet.
- Thin walled components gripped firmly without damage.

This startling new workholder provides all the advantages of conventional spring collets combined with the flexibility of an adjustable jaw chuck. One "Multisize Collet" will replace at least 9 conventional collets and only 11 collets are required to cover a range of $\frac{1}{8}$" to $1\frac{1}{2}$". Several years of research and testing lie behind the "Multisize Collet" Write today for fully illustrated brochure.



THE NEW BURNERD COLLET CHUCK

Designed specifically for Burnerd "Multisize Collets", the new Burnerd Collet Chuck provides an extremely powerful and accurate closing mechanism for the Collets. Capacity $\frac{1}{8}$" to $1\frac{1}{2}$" diameter.

SAFELY FIRST

F. BURNERD & COMPANY LIMITED

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MACHINERY
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